Evaluation Design Report

May 26, 2017

This publication was produced by International Development Group LLC, for review by the Millennium Challenge Corporation.

Burkina Faso Roads Project Economic Analysis and Evaluation

Evaluation Design Report

Contract Number:
MCC-16-CON-002

This report was prepared by International Development Group LLC (IDG) with the following contributors: Hyosun Bae, Eddy Bynens, Steve Crudge, Barak Hoffman, and Hippolyte Lingani.

TABLE OF CONTENTS

LIST OF ACRONYMS

AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
AfDB	African Development Bank
AGETIB	Burkina Faso Infrastructure Works Agency
APD	Development Partnership Agency (Agence du Partenariat pour le Développement)
ATC	Automatic Traffic Count(er)
BB	Benkelman Beam
BI	Bump Integrators
BRIGHT	Burkinabe Response to Improve Girls' Chances to Succeed
CBA	Cost-Benefit Analysis
CBC	Burkina Shippers Council (Conseil Burkinabe des Chargeurs)
CFA	Central African Franc
DG	General Directorates
DGER	General Directorate of Roads Maintenance (Direction Générale de l'entretien routier)
DGESS	General Directorate of Sector Work and Statistics
DGNETC	General Directorate of Standardization, Engineering Studies and Control
DGPR	General Directorate of Rural Roads (Direction Générale des Pistes Rurales)
DGR	General Directorate of Roads (Direction Générale des Routes)
DGTTM	General Directorate of Land and Sea Transport
DP	Development Partner
EAC	East Africa Community
ECOWAS	Economic Community of West African States
ERR/EIRR	Economic (Internal) Rate of Return
FER-B	Road Maintenance Fund of Burkina (Fonds d'Entretien Routier du Burkina)
FSRB	Burkina Faso Special Road Fund (Fonds Spécial Routier du Burkina Faso)
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoBF	Government of Burkina Faso
HDM-4	Highway Development and Management
IDG	International Development Group LLC
IMFPM	Incentive Matching Fund for Periodic Maintenance
IRI	International Roughness Index

ITT	Indicator Tracking Table
KII	Key Informant Interview
LNBTP	National Public Buildings and Works Laboratory
LTPP	Long-Term Pavement Performance
M&E	Monitoring and Evaluation
MCA-BF	Millennium Challenge Account Burkina Faso
MCC	Millennium Challenge Corporation
MEFD	Ministry of Economy, Finance, and Development (Ministère de l'Economie, des Finances et du Développement)
MICA	Ministry of Industry, Commerce, and Artisans (Ministère de l'Industrie, du Commerce et de l'Artisanat)
MOI	Ministry of Infrastructure (Ministère de l'infrastructure)
MTMUSR	Ministry of Transport, Urban Mobility, and Road Security (Ministère des Transports, de la Mobilité Urbaine et de la Sécurité Routière)
OTRAF	Burkina Faso Organization of Transporters
NGO	Non-Governmental Organization (Organiaion des Transporteurs du Faso)
NPV	Net Present Value
O-D	Origin-Destination
PRP	Poverty Reduction Paper
RD	Regional Directorates
RED	Road Economic Decision
SG	Secretary General
SOFITEX	Association of Cotton Producers (Société Burkinabé des Fibres)
SONABHY	National Petroleum Company (Société Nationale Burkinabè d'Hydrocarbure)
ToR	Terms of Reference
UEMOA	Francophone West African Economic and Monetary Union (Union Economique et Monétaire Quest-Africaine)
VAT	Value-Added Tax
VOC	Vehicle Operating Cost(s)

I. INTRODUCTION

Burkina Faso is a landlocked West African country with limited resources, surrounded by Cote d'Ivoire, Ghana, Togo, Benin, Niger, and Mali. A former French colony, Burkina Faso maintains relative political stability and recently elected its first civilian president following free and transparent elections in 2015. While more than 80 percent of its population live in the rural areas, Burkina Faso is experiencing a significant increase of urbanization.[1] The economy of Burkina Faso is heavily reliant on agriculture, mainly consisting of animal husbandry and subsistence agriculture.

Prior to the Compact, Burkina Faso's transportation sector ranked poorly across many international indices. In 2006, the World Economic Forum Competitiveness Rankings placed Burkina Faso 132 out of 144 countries for its quality of roads. In 2007, Burkina Faso's quality of infrastructure ranked 138 among 150 countries on the World Bank's Global Logistics Performance Index (LPI). As of 2007, only 26 percent of Burkina Faso's total rural population lived within two kilometres of an all-season road.[2]

After a two-year preparatory period, the Millennium Challenge Corporation (MCC) signed a $481 million Compact Agreement with the Government of Burkina Faso (GoBF) on July 14, 2008. The Compact consisted of four distinct projects: 1) Rural Land Governance Project, 2) Agriculture Development Project, 3) Roads Project, and 4) Burkinabe Response to Improve Girls' Chances to Succeed (BRIGHT) II Schools Project. The goal of the Compact was to reduce poverty in Burkina Faso through economic growth. The Compact came into force in July 2009 and was in effect for five years until July 2014.

In September 2016, International Development Group LLC (IDG) was contracted by MCC to conduct an economic analysis and a performance evaluation of the Compact's Roads Project. The objective of the Evaluation Design Report is to present research questions and propose appropriate and feasible quantitative and qualitative evaluation methodologies. In this report, the team will: i) provide an overview of the Compact and its Roads Project, ii) present quantitative and qualitative evaluation design for each Research Area, and iii) summarize administrative issues of the evaluation. The Evaluation Design Report incorporates feedback and recommendations from MCC and stakeholders in Burkina Faso.

[1] http://documents.worldbank.org/curated/en/436861469672181908/pdf/700670ESW0P1140Faso000Frinal0Report.pdf

[2] World Bank Rural Access Index

II. OVERVIEW OF THE COMPACT AND THE INTERVENTION(S) EVALUATED

2.1 OVERVIEW OF THE PROJECT AND IMPLEMENTATION PLAN

2.1.1 Original Project Description

When the Compact took effect in July 2009, an autonomous body, the Millennium Challenge Account Burkina Faso (MCA-BF), was established by the GoBF to implement the projects under the Compact. At the design stage, around $194.13 million was allocated for the Roads Project which is nearly 40 percent of the initial MCC Funding. The Roads Project had an objective of enhancing access to markets through investments in the road network. More specifically, the Roads Project was initially designed to: i) improve access to agricultural markets by upgrading primary and rural road segments serving the Sourou Valley and the Comoé Basin, ii) reduce travel time to markets and reduce vehicle operating costs, and iii) ensure the sustainability of the road network by strengthening road maintenance. Details of the four activities under the Roads Project are as follows:

Activity 1 - Development of Primary Roads: To improve three primary road sections totaling 271 km in length in western Burkina Faso. The segments to be financed under the Roads Project were Dedougou – Nouna – Mali border (145 km), Sabou – Koudougou – Didyr (76 km), and Banfora – Sindou (50 km). The development of primary roads included road widening, improvement of drainage facilities and bridges, pavement construction, and bituminous surfacing. A total of $142.23 million was initially allocated for Activity 1.

Activity 2 - Development of Rural Roads: To improve 151 km of rural road segments from rural tracks to a fully engineered rural roads standard in southwestern Burkina Faso. The rural roads development activity occurred in three rural areas of Comoé Basin – Provinces of Léraba, Comoé, and Kénédougou. A total of $17.6 million was initially allocated for Activity 2.

Activity 3 - Capacity Building and Technical Assistance for Road Maintenance: To provide capacity building and technical assistance to existing government agencies and private sector institutions involved in road maintenance activities. In particular, the activity was aimed at improving the capacity of the General Directorate of Roads (*Direction Générale des Routes,* DGR) and the General Directorate of Rural Roads (*Direction Générale des Pistes Rurales,* DGPR) to plan and program the road maintenance network, and procure and supervise construction. Technical assistance on institutional management was envisioned for the Road Maintenance Fund of Burkina (*Fonds d'Entretien Routier du Burkina,* FER-B). A total of $3.3 million was initially allocated for Activity 3.

Activity 4 - Incentive Matching Fund for Periodic Maintenance (IMFPM): To fund periodic maintenance on the condition that the Government fulfilled a certain number of conditions related to maintenance activities including a Government increase in funding for periodic maintenance. MCC Funding was designed to match annual increases in the Government's dedicated funding for periodic maintenance. The IMFPM was to be administered by FER-B and a total of $31 million was initially allocated from MCC for the fund under Activity 4.

2.1.2 Description of implementation to date

Within the first five months of the Compact (August – December 2009), MCA-BF signed contracts to conduct a feasibility design of the primary roads and the rural roads. In 2011, MCC restructured the conditions precedent established for the Roads Project into smaller incremental steps. This amendment allowed timely disbursement of MCC's initial funds to complete the construction within the Compact timeframe. In December 2011, GoBF adopted a 5-year maintenance plan for routine and periodic maintenance, one of the major conditions required to receive initial disbursement of funding.

MCA-BF received bids for primary roads construction in May 2012. The winning bids were significantly over budget. High costs were mainly attributed to higher input costs, lack of qualified international competition, compressed construction schedules, currency instability and spillover effects from insecurity caused by the Mali coup d'état and the 2011 civil unrest in Burkina Faso. MCA-BF considered several options and concluded to reallocate funding from the IMFPM and rural road constructions to primary road construction.

Constructions of primary roads started in 2012 and the construction of rural roads started later, in May 2013. By September 2012, the FER-B was fully operational and periodic maintenance utilizing the IMFPM started in February 2014. Table 2.1 below indicates the final total road length of improved road segments and the total length of roads maintained using the IMFPM.

Table 2.1 MCC Burkina Faso Roads Project: Road Sections and Road Length

Activity	Road Section	Length (km)
Primary road	**TOTAL**	**276.4**
	Dédougou –Nouna –Mali border	143.7
	Sabou –Koudougou – Didyr	82.4
	Banfora –Sindou	50.3
Rural road	**TOTAL**	**144.9**
	Lot 1 Comoé province	61
	Lot 2 Léraba province	35.8
	Lot 3 Kénédougou province	48.1
GRAND TOTALTOTAL		**421.3**

2.1.3 Geographical Coverage

The map of the Roads Project zone of intervention is illustrated below in Figure 2.1. Three primary roads were improved to the west of Ouagadougou. The Dédougou –Nouna – Mali border primary road provides a more direct route from Ouagadougou to Bamako of Mali. By shortening the detour, the route is intended to build a new economic corridor and generate traffic between the two countries.

The roads that received periodic maintenance using the IMFPM are distributed throughout the country and not limited to MCC-funded roads. Yet, the rural roads improved under the Compact are concentrated in the southwest region of Burkina Faso as shown in the map.

Direct beneficiaries of the improved primary roads and rural roads are all transport users. The primary users of roads include car owners, transport companies and industries, and the road sector administration. Other indirect sectors benefitting from the improved roads are: (a) the agricultural

sector benefiting from the improved accessibility to production areas as a result of the road improvement; (b) the construction industry benefiting from the creation of jobs induced by the road works and the gains in travel time; (c) the public sector such as Ministries and parastatal entities in the transport sector benefitting from the institutional support and training provided through the Roads Project; and (d) the trade industry benefitting from improved trade facilitation due to enhanced circulation of persons and goods.

2.2 PROGRAM LOGIC/THEORY OF CHANGE

Transport infrastructure is often an important factor in determining the location of economic activity and the kinds of activities or sectors that can develop within a country.[3] Some studies illustrate that the provision of rural roads and transport services are closely linked to improvements in rural health, education, agricultural production, and incomes.[4] Therefore, extensive and efficient transport infrastructure is critical to ensure an effective economy and the alleviation of poverty.

Especially for a landlocked country like Burkina Faso, the road transport network is an important asset for economic development. The goal of the Compact is to reduce poverty in Burkina Faso through economic growth and the Roads Project contributes to economic growth by enhancing access to markets through investments in the road network. Such a network facilitates trade and communications with regional and international markets and improves local connectivity of farms to markets. Road network investments are also intended to improve access to social services in rural communities, such as those in western Burkina Faso, which have been underserved by an adequate transport system.

The project logic below (Figure 2.2) describes the expected causal chain of events leading from the Roads Project's inputs and project activities to outputs, to immediate and intermediate changes in the target population, and to the achievement of long-term outcomes leading to project objective. Based on the inputs from MCC and MCA-BF, four activities were designed under the Roads Project. For the first two activities, MCC selected three segments of primary roads and three lots of rural roads to improve the road quality. The selected primary and rural roads were upgraded to appropriate functional standards and designed to carry projected traffic for a 15- to 20-year horizon. The upgraded roads would save costs of vehicle operation and travel time for road users. Improved road quality could also provide access to health and education services.

Acknowledging Burkina Faso's limited institutional capacity in road maintenance as a main risk to the sustainability of the Project, MCC also provided capacity building and technical assistance on road maintenance to GoBF institutions. As a result, the Ministry of Infrastructure (*Ministère de l'infrastructure,* MOI) adopted the five-year routine and periodic maintenance plan and six individuals from the Ministry were trained on road maintenance. The activity was intended to strengthen the capacity of government agencies and private sector institutions involved in road maintenance. In addition to improved quality of the roads from better maintenance, an effective road maintenance mechanism would increase reliability and sustainability of national road network in Burkina Faso.

[3] David A. Aschauer, Is public expenditure productive? Journal of Monetary Economics, 23 (1989); David. Canning, M. Fay, The effect of infrastructure networks on economic growth, Columbia University, New York, NY (1993); Edward Gramlich, Infrastructure Investment: a review essay, Journal of Economic Literature, 32-3 (1994)
[4] http://siteresources.worldbank.org/EXTRURALT/Resources/515369126460585536 8/investment_efficiency.pdf

Figure 2.1 Map of Burkina Faso Roads Project Zone of Intervention

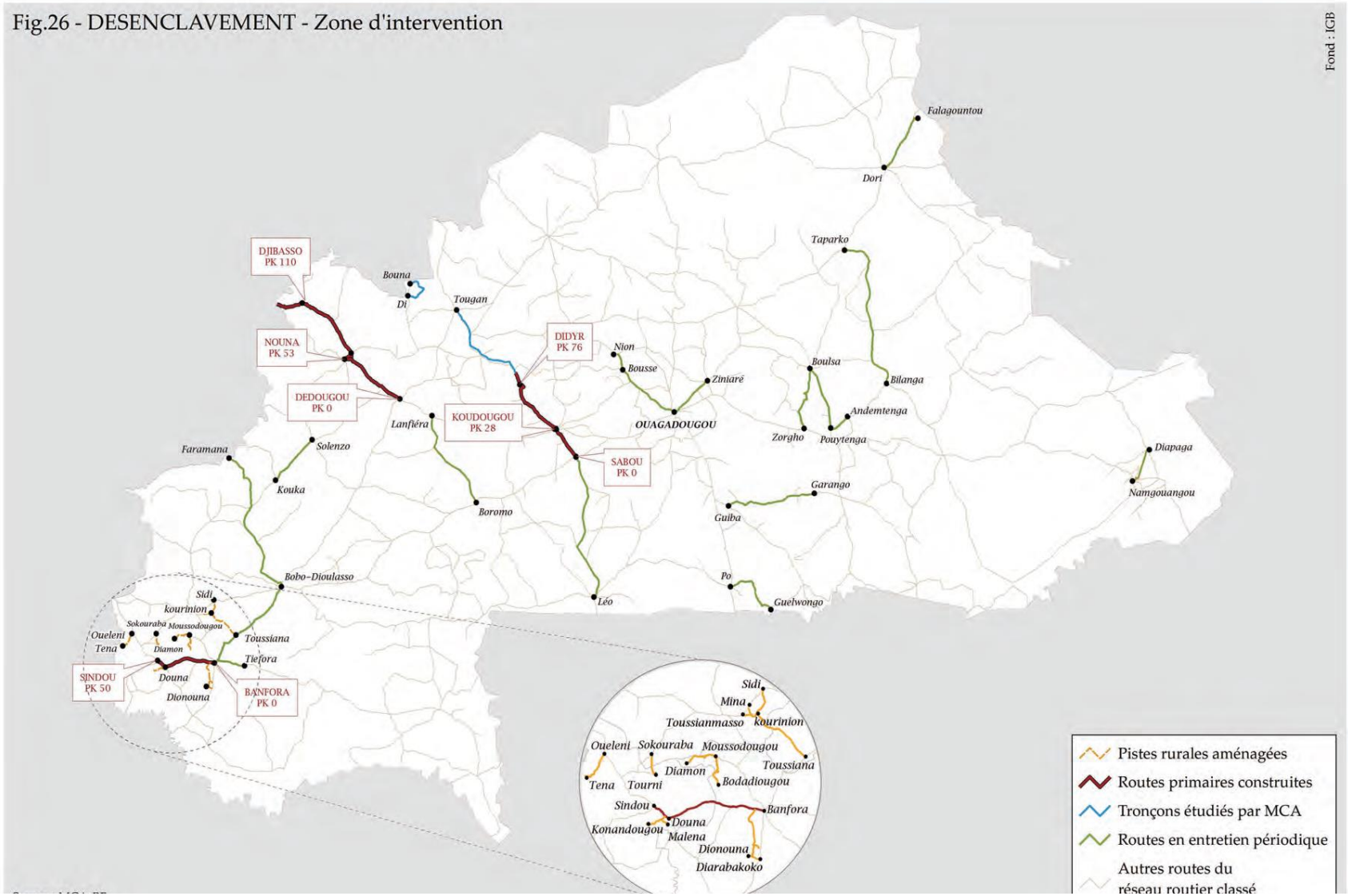
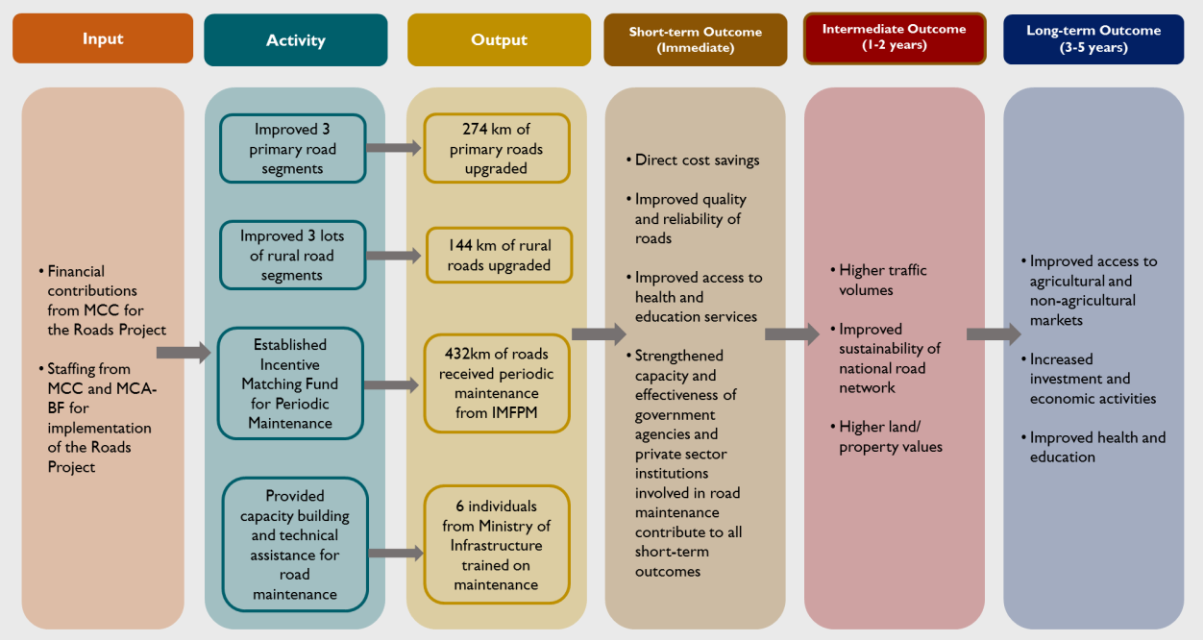


Figure 2.2 MCC Roads Project Logic[5]



In 2007, GoBF funded its road routine maintenance with annual budget of 9.5 billion F CFA, but only 4.5% of the budget was used for periodic maintenance.[6] Persistent difficulties in resource mobilization led to delays of periodic road maintenance up to eight months in arrears.[7] MCC recognized that financing (or the political will to finance) periodic road maintenance is critical to the sustainability of the MCC-funded roads. Under the Roads Project, MCC established IMFPM to fund periodic road maintenance. By matching the GoBF's dedicated annual funding for periodic maintenance, the IMFPM was intended to encourage gradual increase in government funding for periodic maintenance.

The four activities and outputs compound to achieve the short-term outcomes expected from the Roads Project - increased access to services, upgraded road quality, and improved reliability of the roads. Higher traffic volumes and increased property values in rural areas of Burkina Faso are expected as an intermediate outcome of the Roads Project. Finally, the causal pathways collectively imply that Burkina Faso will experience improved access to agricultural and non-agricultural markets, increased investment and economic activities, and improved health and education.

[5] The figure is based on "Burkina Road Logic v4 July 7 2013", an updated version of the program logic.
[6] Project Description Roads Burkina document
[7] Implementation Completion and Results Report, Burkina Faso Transport Sector Project, World Bank Group, 2014.

III. EVALUATION DESIGN OVERVIEW

3.1 EVALUATION TYPE

The evaluation of the MCC Burkina Faso Roads Project is mainly two-fold: 1) an economic analysis will be conducted to understand the costs and benefits of the MCC-funded roads (Research Area 1, 3, and 5), and 2) performance evaluations of the maintenance and transport sector activities will be conducted to complement and enhance knowledge gained through the economic analysis (Research Area 2 and 4).

The *economic analysis* consists of three integrated research areas as follows[8]:

Research Area 1 tests the economic viability of MCC-funded roads by conducting a cost-benefit analysis (CBA) to estimate the economic rate of return (ERR) and net present value (NPV) of the roads. The CBA will employ the Highway Development and Management (HDM-4) model, an analytical tool used to conduct CBA for roads. Data collected for Research Area 3 and Research Area 5 will inform the HDM-4 model and the final model will be updated based on the repeated traffic counts (Research Area 5).

Research Area 3 is a study of road users, based on origin-destination (O-D) surveys on segments of the MCC-funded roads. The data collected from the O-D surveys will inform the HDM-4 model. Other than the information required for Research Area 1, the evaluation will also analyze additional qualitative information on the road users to understand the characteristics of the road users and their travel patterns. Information such as the cost and duration of the trips and value of the goods being transported will be analyzed.

Research Area 5 is a study of traffic growth on the MCC-funded roads. Traffic counts are a critical component of the HDM-4 model. While only a single traffic count is required for the HDM-4 model, a repeated traffic count will be conducted twice per year. The evaluation will analyze the traffic of MCC-funded roads over time to understand the patterns in change of traffic. The analysis will also attempt to identify the cause of change in traffic. Information collected from the final traffic count will be used to update the HDM-4 model.

The *performance evaluations* are centered around two thematic areas as below:

Research Area 2 will evaluate the road maintenance regime within the GoBF to test the sustainability of improvement in road infrastructure. A political economy analysis will be conducted to examine the effect of the road maintenance activities under the Roads Project. The analysis will improve MCCs assumption on post-Compact maintenance and project-life assumptions about its infrastructure investments. HDM-4 model's assumptions on road maintenance will be informed based on the road maintenance analysis.

Research Area 4 is a study on the transportation market structure of Burkina Faso. While transportation service is an area MCC did not directly work in, analysis of the formal and informal instructions of the transportation market will inform whether vehicle operating cost savings were passed on to road users who do not own their own vehicle. In particular, costs for public transport

[8] The Research Areas are numbered to correspond to the contract. This section ordered the Research Areas differently based on the overall evaluation approach.

users and farmers transporting their produce to market will be analyzed to understand whether cost savings were transferred in the form of lower fares for people and goods.

3.2 EVALUATION DESIGN OVERALL APPROACH

The evaluation will consist of the following:

Key Outcomes	Data Source	Data Type
Research Area 1: Cost-Benefit Analysis of MCC-funded Roads		
• Direct cost savings to road users • Improved quality and reliability of roads	Road structure and conditions Road users	**Quantitative** - Cost benefit analysis using HDM-4 - Manual traffic counts; road roughness survey; surface distress survey; O-D survey; road inventory survey; deflection measurement survey; pavement structure survey; VOC survey; maintenance cost survey
Research Area 2: Political Economy Analysis of Road Maintenance		
• Strengthened capacity and effectiveness of government agencies and private sector institutions • Improved quality and reliability of roads • Improved sustainability of national road network	Local stakeholders Relevant official and project documents	**Quantitative** - Road roughness survey - Surface distress survey **Qualitative** - Key Informant Interview (KII) - Review of relevant documents
Research Area 3: Study of Road Users		
• Improved access to health and education services • Improved access to agricultural and non-agricultural markets	Road users Public transport users	**Quantitative** - Origin-Destination survey - Public transport user survey
Research Area 4: Study of Transport Market Structure		
• Direct cost savings • Improved access to health and education services • Improved access to agricultural and non-agricultural markets	Local stakeholders Road users Public transport users and farmers Relevant official and project documents	**Qualitative** - Key Informant Interview (KII) - Review of relevant documents **Quantitative** - Public transport user survey - Vehicle operating cost savings

Key Outcomes	Data Source	Data Type
Research Area 5: Study of Traffic Growth		
• Higher traffic volumes	Classified manual traffic counts	**Quantitative** - Manual traffic count

IV. EVALUATION DESIGN – RESEARCH AREA 1: COST-BENEFIT ANALYSIS OF MCC-FUNDED ROADS

4.1 EVALUATION QUESTIONS

1) **Did MCC's Road Project design maximize the potential for positive economic returns?**

The purpose of this question is to review the executed design of the MCC's Roads Project and provide recommendations, if any, for potential areas of future optimization that may improve the economic returns.

The preliminary findings indicate that the final approval of the investment in the Roads Project appear to have been based on factors other than highway economics. The realized designs of the roads were, in economic terms, sub-optimal. Lower design standards with simple, cheap and appropriate road improvement schemes would have improved the cost/benefit balance moderately. A shift from the improvement of a set of rural roads to paving primary roads was also not based on economic reasons. The Evaluation Team will continue to assess the methodology behind the selection of the Roads Project.

2) **What is the confirmed ERR for each road section?**

Determining the cost effectiveness of project investment is one of MCC's core principles. The economic viability of the MCC Roads Project will be calculated by comparing the final project costs and the benefits for road users.

Based on preliminary observations, the team expects the ERR results will continue to show poor economic performances for each of the road project sections. However, precise confirmation of the economic results for each road section will be calculated using a detailed analysis using HDM-4 based on extensive survey work.

4.2 EVALUATION APPROACH

4.2.1 Existing Data

Pre-Compact ERR

MCC's Burkina Faso Roads Project upgraded a total of 276.1 km of primary roads to paved bitumen standard and a total of 144.8 km of rural roads to engineered standard in the Comoé basin of southwest Burkina Faso.

There were no economic evaluations for rural road investments as the justification for improving the rural roads primarily focused on granting rural areas of Burkina Faso accessibility to markets.

The economic evaluation of the primary roads was carried out using the Roads Economic Decision (RED) model. In the case of the primary roads for the Roads Project, the use of RED appears reasonable; traffic volumes are low and, prior to upgrading, subject to seasonal disruption.

The primary roads under evaluation were as follows:

- Dedougou – Nouna – Mali border
- Banfora – Sidou
- Sabou – Koudougou – Didyr

For the purposes of the economic evaluation using RED, the three roads were broken down into seven shorter sections as follows:

1. Dedougou – Nouna
2. Nouna – Bamboroquy
3. Bamboroquy – Mali border
4. Banfora – Sidou
5. Sabou – Koudougou
6. Koudougou – Perkoa
7. Perkoa – Didyr

A RED evaluation was conducted for each of the above-mentioned road sections. All seven evaluations applied the following principal parameters, which can be considered appropriate to the timing and purpose of the modeling:

- Traffic base year: 2008
- Evaluation period: 20 years (2007 - 2027)
- Discount rate: 10 percent
- Traffic growth: 4.5 percent per annum over 20 years
- Post-scheme road condition: International Roughness Index (IRI) 3.5

The economic results prior to the Compact are consistently poor. The highest EIRR of all the sections was 2.7 percent, which is well under the recommended target of 12.7 percent.[9] Table 4.1 below summarizes the results of the seven road sections evaluated. The principal reasons for poor economic performance are low daily traffic volumes (all under 250 vehicles with four+ wheels per day) and relatively high project input costs (from F CFA 156,000 - 194,000 per km).

Table 4.1 Pre-Compact Summary of Burkina Faso Primary Roads Economic Evaluation Results

Section No.	From	To	EIRR (%)
1.1b-I	Dedougou	Nouna	2.7
1.1b-II	Nouna	Bamboroquy	-3.3
1.1b-III	Bamboroquy	Mali border	-2.5
1.5b-I	Sabou	Koudougou	0.1
1.7-I	Koudougou	Perkoa	-1.6
1.7-II	Perkoa	Didyr	-0.8

[9] The hurdle rate of 12.7 percent was based on MCC's practice/policy of 2007, which stated "the hurdle rate for countries was calculated by multiplying by 2 the average of the previous three years GDP growth rates. In addition, no hurdle rate was to be less than two times the average GDP of all countries, which in FY 2007 was 10.8%. No hurdle rate was to exceed 15.0% either."

1.3-II	Banfora	Sidou	1.0

Note: Analysis used RED
Discount rate =10 percent

The combination of low traffic volumes and high costs lowered the projected economic return even where there would be significant road surface improvement (in most cases there is a reduction of 10m/km in the international roughness index between existing and improved road). There does not appear to be enough road users on any of the sections to justify the proposed level of investment even with healthy traffic growth rates and allowance for generated traffic. In addition, given the increased construction costs encountered in implementation, the estimated economic performance would have reduced further post-Compact.

In conclusion, the road improvement projects as modeled were not economically viable for the proposed road sections. It is reasonable to ask why one or more of the following options do not appear to have been adopted for the Roads Project:

- Postponement of the proposed investments until they are significantly more attractive, in economic terms;
- Adoption of simpler, cheaper design alternatives;
- Consideration of other more suitable road sections with a stronger economic case; and/or
- Application of a wider set of evaluation criteria to justify the Roads Project.

Ministry of Infrastructure's Use of ERR Data

The Evaluation Team's first field trip to Burkina Faso included a meeting with the General Directorate of Standardization, Engineering Studies and Control (DGNETC) of the MOI. The DGNETC is responsible for conducting highway economic evaluations in Burkina Faso.

Currently, the DGNETC uses HDM-4 and their database includes extensive road network coverage including all primary roads and many rural roads. However, the DGNETC and its consultants still use Level-1 calibration of HDM-4, which is a desk study of available data and engineering experience that uses many default values with best estimates calibrating the most sensitive parameters. The current five-year maintenance plan for 2013-17 uses the Level-1 calibration of HDM-4.

A Level-2 calibration study, which requires measurement of additional inputs and moderate field surveys to calibrate key predictive relationships to local conditions, was conducted on behalf of MOI with support from German Corporation for International Cooperation (GIZ) and MCC. While the final report was issued in early 2014, its recommendations and the resulting HDM-4 workspace have not yet received final official approval.

In terms of the extensive data collection required by HDM-4, current responsibilities from the GoBF are found to be as follows:

- Traffic counting: MOI General Directorate of Sector Work and Statistics (DGESS) supported by Regional General Directorates (DGs) and Provincial DGs;
- Road inventory: MOI DGESS supported by Regional DGs and Provincial DGs;
- Road roughness measurement: MOI DGESS;
- Road structure and strength measurement: National Public Buildings and Works Laboratory (LNBTP); and

- Vehicle fleet and operating cost data: nominally Ministry of Transport, Urban Mobility, and Road Security (*Ministère des Transports, de la Mobilité Urbaine et de la Sécurité Routière,* MTMUSR) but there is no evident interaction with DGNETC on HDM-4.

The Evaluation Team included the HDM-4 Level 1 Calibration Report as an Annex to the Evaluation Design Report, which was drafted in parallel based on existing sources of data, both from within and outside MCC.

4.2.2 Methodology

The CBA compares the costs (capital and recurrent) of road investment with the resultant benefits to road users. These benefits primarily comprise of vehicle operating costs (VOC) and travel time savings, although reductions in accident costs and future maintenance savings can also be evaluated.

Time savings, VOCs, and accident costs result from combinations of improvements in road standard/design, alignment and surface condition (notably roughness), future maintenance savings from improvements in road surface condition and structural strength. The improvement scheme is compared to a base or do minimum situation in which the unimproved road continues to be maintained in line with established procedures.

HDM-4, originally developed by the World Bank, is now accepted as the premier model for the economic evaluation of international road rehabilitation and improvement schemes. RED model is a spreadsheet-based model which performs a similar function to HDM-4 and is considered the more appropriate tool when one or more of the following factors are significant:

- Low levels of daily traffic;
- Seasonal interruptions to road operation;
- Road construction is less than fully engineered, or;
- Data, particularly engineering data, is limited.

The output of the CBA, whether carried out using HDM-4 or RED, consists of measures of economic viability, principally NPV and Economic Internal Rate of Return (EIRR). Basic economic viability is generally considered to be achieved if NPV is positive and EIRR is greater than the specified hurdle rate, as a percentage.

The RED economic analysis provides a breakdown of the predicted benefits of the proposed road scheme (upgrading to bitumen standard in the case of primary roads). The RED-modeled economic benefits include:

- Travel time savings to road users, by vehicle class;
- Vehicle operating cost savings to road users, by vehicle class;
- Maintenance cost savings to the road agency;
- Accident savings to road users, by vehicle class (optional and not used in the project runs), and;
- Other benefits external to the economic evaluation.

Other benefits refer to any benefits attributable to the project that can be quantified in monetary terms and calculated outside the RED software (such as agricultural surplus). Evaluators can combine RED and other assessment benefits, ensuring there is no double counting, to better reflect the wider benefits of the project.

The predominant road user benefits in Burkina Faso are VOC savings, which comprise 75 percent or more of economic benefits calculated in the RED analysis. This is due to poor road surface conditions prior to project implementation. Time savings are relatively insignificant because of low value of time in Burkina Faso. Accident benefits are not calculated.

As discussed in further detail below, the Evaluation Team broadly confirmed that the traffic volumes on MCC-funded primary roads remain low while the design standards (and consequently construction and maintenance costs) of the paved roads are high. It is to be expected that the economic performance of such projects was, and if updated would remain poor. The fundamental parameters of the economic analysis have not been invalidated.

In discussions with the MCC, the Evaluation Team verified that a rigorous economic analysis will confirm the economic returns of the MCC-funded roads beyond reasonable doubt, in spite of an acceptance that the results are likely to remain poor.

Therefore, the Evaluation Team proposes to put forward two alternative approaches to the design of the economic evaluation (details of each option are elaborated below):

- A more robust, more extensive data collection exercise in which, within time and budgetary constraints, the maximum amount of fresh information is collected; and
- A less intensive set of surveys where greater emphasis is placed upon the application and adaptation of available data.

4.2.3 Summary of Data Collection Options

The Evaluation Team proposed two alternative approaches to the economic evaluation. Option 2: Standard Approach represents standard practice data collection parameters for HDM-4 as deemed appropriate by the Evaluation Team. Option 1: Comprehensive Approach entails expanded data collection to add an additional level of rigor to the analysis, as discussed with MCC regarding their expectations.

Based on the feedback from the stakeholders and MCC, the Evaluation Team selected a hybrid of the two approaches – Standard and Comprehensive – as highlighted in green below:

Table 4.2 Summary of HDM-4 Data Collection Options

No.	Data	MCC Road Type	Option 1: Comprehensive Approach	Option 2: Standard Approach
1	**Manual Traffic Counts**	Primary Roads	A minimum of 7-days/24-hour duration traffic counts conducted at 11 Roche count station locations and at 5 additional mid-point locations between towns[10] (total 16)	A minimum of 7-days/24-hour duration traffic counts conducted at 11 Roche count station locations
		Rural Roads[2]	A minimum of 7-days/12-hour duration traffic counts including one day of 24-hour conducted at 10 locations overlapping with the post-compact Roche evaluation locations	No Data Collection
		Periodic Maintenance Roads[2]	A minimum of 7-days/12-hour duration traffic counts including one day of 24-hour conducted at 21 locations overlapping with the post-compact Roche evaluation locations	No Data Collection
2	**Road Roughness Surveys**	Primary Roads	Roughness measurements collected using Bump Integrator for each project road every 100m	Roughness measurements collected using Bump Integrator for each project road every 500m
		Rural Roads[2]	Roughness measurements collected using Bump Integrator for each project road every 100m	Roughness measurements collected using Bump Integrator for each project road every 500m
		Periodic Maintenance Roads[2]	Roughness measurements collected using Bump Integrator for each project road every 100m	Roughness measurements collected using Bump Integrator for each project road every 500m
3	**Surface Distress Surveys**	Primary Roads	Detailed measurements of other surface distress measured every 1km	Surface distress classified as good, fair, poor, or bad
		Rural Roads[2]	Detailed measurements of other surface distress measured every 1km	Surface distress classified as good, fair, poor, or bad
		Periodic Maintenance Roads[2]	Detailed measurements of other surface distress measured every 1km	Surface distress classified as good, fair, poor, or bad
4			A minimum of two roadside O-D surveys (total 6)	A minimum of one roadside O-D surveys (total 3)

[10] Option 1: Comprehensive Approach for manual traffic counts on primary roads covers all 11 Roche stations on the primary roads, 6 of which are at mid-point locations. 5 Additional mid-point locations between towns are added which are not covered by the Roche stations.

No.	Data	MCC Road Type	Option 1: Comprehensive Approach	Option 2: Standard Approach
	Origin-Destination Survey	Primary Roads	A minimum of 3-day survey per traffic direction and 12-hour duration	A minimum of 2-day survey per traffic direction and 12-hour duration
			A minimum target sample rate of 25 percent	A minimum target sample rate of 20 percent
5	**Road Inventory Survey**	Primary Roads	Road length, width, shoulder width, curvature, and rise/fall data collected every 1km	Review and adjust MOI's existing data on road inventory
6	**Deflection Measurement Survey**	Primary Roads	Deflection measurements collected at least every 100m using Benkelman Beam	Deflection measurements collected at least every 500m using Benkelman Beam
7	**Pavement Structure Survey**	Primary Roads	Core sampling where visual distress survey and/or deflection measurements indicate a potential problem	Review and use as-built drawings/specification
8	**Vehicle Operating Cost Survey**	Primary Roads	VOC data collected from vehicle dealers, parts suppliers, and vehicle operators	Review and adjust existing MOI dataset on VOC
9	**Axle-Load Survey**	Primary Roads	A minimum of one axle-load survey in which heavy vehicles are weighed by axle at the roadside	Review and adjust MOI's existing data and recent studies on axle-loads
10	**Maintenance Cost Survey**	Primary Roads	Maintenance cost data collected from appropriate sources	Review and adjust MOI's existing data where necessary on maintenance costs
11	**Public Transport User Survey**[3]	Primary Roads	A minimum of two public transport user survey at bus stations on each primary road	A minimum of one public transport user survey at bus stations on each primary road

Notes:

[1] *Boxes shaded in light green indicate the final data collection approaches selected by the Evaluation Team for Research Area 1 data collection.*

[2] *Data collection for rural roads and periodic maintenance roads is not required for the HDM-4 analysis. However, they are included in Table 4.2 to provide an overview of data collection for all types of roads. Cost savings from excluding data collection on rural roads is estimated at US$ 54,000. Cost savings from excluding data collection on periodic maintenance roads is estimated at US$ 34,000.*

[3] *Data collection for the public transport user survey is not required for the HDM-4 analysis. However, they are included in Table 4.2 to provide an overview of data collection for all types of roads.*

4.2.4 Data Collection Details

Manual Traffic Counts

Primary Roads: A minimum of 7-days/24-hour duration traffic counts will be conducted at 11 stations used by Roche on MCC-funded primary roads and at 5 additional mid-point locations between towns not covered by Roche stations (see Chapter 8 of this report, Table 8.1 for the traffic count locations). Among the 11 Roche counting station locations, 6 are located at mid-point locations between towns. Counts will be located to avoid road sections with significant local traffic.

In addition to these, Roche conducted traffic counts at 23 locations where secondary roads connected to the MCC-funded primary roads in order to differentiate traffic generation and traffic diversion. However, the Evaluation Team believes that there is marginal value in adding 23 additional counting stations. Traffic counts standalone are limited and cannot determine "normal traffic", "generated traffic", and "diverted traffic" with certainty. O-D surveys need to be accompanied to provide a clearer understanding of traffic diversion versus generation. Therefore, the team will not conduct the traffic counts at the 23 connecting locations but focus on the 11 mid-point locations and the 5 additional Roche locations.

The primary road traffic count data for HDM-4 will draw from data collected under Research Area 5, a study on traffic growth over time. Therefore, further detail of the traffic count program is included in Chapter 8 of this report.

Rural Roads: A minimum of 7-day/12-hour duration traffic counts will be conducted, including one day of 24-hour traffic count, at 10 locations on MCC-funded rural roads in line with count stations selected by Roche post-Compact.

Periodic Maintenance Roads: The Evaluation Team will not conduct traffic counts on the periodic maintenance roads. Since MCC did not directly upgrade these roads, conducting manual traffic counts on these roads is a lower priority. The Evaluation Team also does not expect the traffic counts on periodic maintenance roads to greatly differ from the traffic counts conducted by Roche in 2014-15 on the periodic maintenance roads.

Road Roughness Surveys

Primary Roads: Roughness measure, IRI, is an important data parameter for HDM-4 modeling. Survey vehicles equipped with calibrated Bump Integrator (BI)[11] will traverse over each of the project primary road sections in both directions at a consistent and suitable speed to collect readings on roughness every 500m. The results will be processed and analyzed to provide average roughness per homogeneous traffic section (see Table 4.3 for details on road sub-sections). Where the results show significant variations within a homogeneous traffic section, HDM-4 will model the differences in surface condition while retaining the same traffic characteristics.

Rural Roads: The Evaluation Team will collect IRI using survey vehicles equipped with calibrated BI on rural road sections in both directions on roughness every 500m. The results will

[11] According to information obtained from LNBTP, the Ground Penetrating Radar (GPR) was tried on the airport runway in Burkina Faso and gave acceptable results on the thickness of the asphalt layer but had difficulty distinguishing between different Natural Lateritic Gravel (NLG). GPR is not readily available in Burkina Faso and may not be suitable for the MCC-funded road structure which consists of surface treatment and NLG layers. Therefore, the team will use Bump Integrator to measure road roughness on paved and gravel roads.

be processed and analyzed to provide average roughness per homogeneous traffic section. Roche collected IRI on the rural roads in 2014-15 and the team will repeat these IRI measurements to examine changes in the IRI.

Periodic Maintenance Roads: The Evaluation Team will collect IRI using survey vehicles equipped with calibrated BI on periodic maintenance road sections in both directions every 500m. The results will be processed and analyzed to provide average roughness per homogeneous traffic section. Roche collected IRI on the periodic maintenance roads in 2014-15 and the team will repeat these IRI measurements to examine changes in the IRI.

Surface Distress Survey

Primary Roads: Given the roads were recently upgraded and are currently in good condition, no detailed survey of road surface distress will be conducted. The Evaluation Team will instead drive over the surveyed roads and classify the surface distress as good, fair, poor, or bad for each road sections, focusing on areas of visible distress. The classification of road surface quality will be based on the Long-Term Pavement Performance (LTPP) Program Distress Identification Manual. In addition, any areas of evident deterioration will be noted. The team will ensure that the results are compatible with the HDM-4 inputs, which may require minor adjustments to the LTPP method. Any potential cases of adjustments will be highlighted prior to undertaking the surface distress surveys during Phase II. The causes of any pavement deterioration will be assessed by the Senior Pavement Engineer in consultation with the local Transport Expert.

Rural Roads: The same methodology will be used on rural roads to evaluate surface distress, focusing on areas of visible distress. Any areas of evident deterioration will be noted.

Periodic Maintenance Roads: The same methodology will be used on periodic maintenance roads to evaluate surface distress, focusing on areas of visible distress. Any areas of evident deterioration will be noted.

Origin-Destination Survey

A minimum of one roadside O-D surveys (a total of three) will be conducted per MCC-funded primary roads (see Chapter 6 of this report, Table 6.1 for the O-D survey locations). The surveys will last for at least two days per traffic direction (directions to be surveyed separately) and be of 12-hour duration (0600-1800). Each survey will be accompanied by a manual traffic count to provide interview sample rates and include at least one 24-hour count. The minimum target sample rate will be 20 percent (one out of every five vehicles interviewed).

The O-D survey data for HDM-4 will draw from data collected under Research Area 3, a study on road users. Therefore, further detail of the O-D survey is included in Chapter 6 of this report.

Road Inventory Survey

The HDM-4 workspace held by DGNETC of MOI breaks down the three MCC-funded primary roads into sub-sections shown in Table 4.3 below. The Evaluation Team will review the sub-sections' inventory and adjust where necessary to use existing data on road inventory.

Table 4.3: MCC-funded Primary Road Sections

Road no./ Section no.	From	To	Km
RN14-13	Dedougou	Koudougou mossi	11.7

Road no./ Section no.	From	To	Km
RN14-14	Koudougou mossi	Kolonkoura	38.0
RN14-15	Kolonkoura	Nouna	5.4
RN14-16	Nouna	Soin	6.7
RN14-17	Soin	Konakoira	17.4
RN14-18	Konakoira	Bomborokui	13.4
RN14-19	Bomborokui	Djibasso	25.8
RN14-20	Djibasso	Mali border	21.4
RR21-1	Banfora	Wolonkoto	25.0
RR21-2	Wolonkoto	Douna	15.2
RR22-2	Douna	Sindou	8.6
RN13-7	Koudougou	Sourgou	16.9
RN13-8	Sougou	Sabou	10.3
RN21-1	Koudougou	Reo	12.2
RN21-2	Reo	Didyr	37.6

Source: MOI DGNETC
Note: Section reference numbers are from the MOI HDM-4 workspace

Deflection Measurement Survey

The team will collect deflection measurements using Benkelman Beam (BB)[12] every 500m of each primary road on the outer wheel path. The measurement will be taken immediately after the end of a rainy season (November 2017). The team will process the road depth and deflection data to calculate Structural Number (SN) representing the road strength for each section of the primary roads surveyed. Where appropriate, the core samplings from pavement structure surveys will be used to verify the as-built road depth data. These results will be also used to determine the remaining structural life of the road investment.[13]

- Deflection measurement: in mm
- Road depth: latest surface in mm
- Road depth: previous/old surfaces in mm
- Date of last reconstruction for the road section surveyed

Pavement Structure Surveys

Core sampling will be conducted on primary roads where problems with the pavement are suspected. Core sampling will be conducted following the two-stage approach as below:

- Parallel to the Deflection Surveys, conduct core sampling every 500m but only at locations with obvious surface defects to reveal any significant discrepancies from the as-built drawings/data.

[12] According to the ToR, the GoBF is to provide Falling Weight Deflectometer (FWD) measurements before the assignment and the Evaluation Team is to use the FWD for all primary roads. Roche similarly intended on using the FWD for deflection measurements but the subcontractor was not able to provide the equipment. There is no evidence that the GoBF has used FWD before. Therefore, the Evaluation Team will use the Benkelman Beam (BB) to collect deflection measurements on the primary roads.

[13] This is an outline methodology based upon the application of the results in the economic evaluation using HDM-4. A more detailed methodology, forming a task-specific terms of reference, will be produced early in Phase 2.

- Following the analysis of the deflection survey results, conduct a further set of core sampling where the deflection results indicate significant structural problems (and not covered by the initial sample).

Vehicle Operating Cost/Vehicle Fleet Data Surveys

The team will collect information to develop a dataset of operating costs representative of the vehicle fleet on MCC-funded Roads at present and in the immediate future. The VOC data required by the HDM-4 economic evaluation will have three primary sources:

- Origin-Destination surveys (Research Area 3)
- Traffic count (Research Area 5)
- A specific VOC survey of vehicle operators, traders, garages and workshops

The traffic surveys (O-D surveys and traffic counts) will reveal the predominant vehicle classes in use on MCC-funded primary roads and the most significant vehicle models within those classes. The VOC researchers will then interview traders, operators, and workshops which handle these common vehicle models. Interviews will take place in major towns served by the MCC-funded primary roads (Kedougou, Dedougou and Banfora), in Ouagadougou, and possibly in Bobo Dioulasso.

The team will collect the information below to estimate financial and economic cost of operating vehicles in Burkina Faso:

- Vehicle characteristics: number of axles and wheels, operating weight, axle-loading value, number of occupants, and work/non-work split[14]
- Vehicle utilization data: annual km, annual working hours, and average service life in years
- Vehicle costs: vehicle price, tire type and price, lubricant type and price, fuel, maintenance costs, driver costs, overhead costs, interest rates on vehicle loans, and taxes and subsidies on vehicle ownership and operation

The number of interviews with those in the vehicle business will, in part, be determined by the range of responses received but will aim to provide a representative and robust sample of the existing vehicle fleet operating on MCC-funded roads.

Axle Load Surveys

The Evaluation Team will review and adjust where necessary to use existing data on axle load survey from the MOI and other studies.

Maintenance Cost Surveys

The Evaluation Team will review and adjust where necessary to use existing data on maintenance costs from the MOI and its consultants.

4.2.5 General Data Collection

Instrumentation

The team will use the following principal automated instrumentation to conduct the economic analysis of the improved roads:

[14] The O-D survey (Research Area 3) and traffic count (Research Area 5) will also contribute significantly to collecting information vehicle characteristics.

- Road roughness surveys: Vehicle-mounted BI
- Deflection measurement surveys: Vehicle-hauled BB
- Pavement structure survey: Mobile core drilling equipment

The other specified surveys will be predominantly manual.

This is an outline methodology based upon the application of the results in the economic evaluation using HDM-4. A more detailed methodology, forming a task-specific terms of reference, will be produced early in Phase 2.

Staffing

The Evaluation Team will recruit the following staffing for the surveys as follows:

- Traffic counts: teams of a minimum of six counters plus one supervisor (supervisor's remit to include more than one survey station)
- Road roughness surveys: teams of four, including driver – maximum of three teams, led by Senior Pavement Engineer
- Surface distress surveys: teams of two, driver and Senior Pavement Engineer
- O-D surveys: teams of six persons with one supervisor (staff will be selected from the most capable and personable traffic counters)
- Road inventory surveys: Senior Pavement Engineer
- Deflection measurement surveys: teams of two, driver and Senior Pavement Engineer
- Pavement structure survey: teams of four, including driver – maximum of three teams, led by Senior Pavement Engineer
- VOC surveys: teams of three-four, trainee economist or equivalent standard, one per Project Road area
- Maintenance cost surveys: Team Leader/Road Maintenance Expert
- Public transport user surveys: teams of four persons with one supervisor – staff to be of equivalent standard to O-D surveys

The GoBF institutions have considerable experience of many of these survey types. Potential areas of capacity within GoBF are listed below:

- The regional directorates (RDs) have the capacity to carry out the traffic counts, the inventory surveys, and with some project assistance the O-Ds;
- The MOI has the capacity to carry out the road condition surveys using a combination of expertise based in Ouagadougou and in the RD; and
- The LNBTP have the capacity to carry out the road strength and structure measurements although it is recommended that an international highway engineer oversee the full program.

The Evaluation Team will hire a Survey Manager and a Survey Coordinator who will be responsible for the conduct of the traffic surveys, reporting directly to the Evaluation Team. The engineering surveys, likewise, will be supervised by an experienced highway engineer from an engineering firm who will plan operations and take responsibility for the processing and analysis of survey results.

Geographic Data Collection

The Evaluation Team will collect Global Positioning System (GPS) coordinates at data collection points or the section of the road where the data is being collected (beginning and end point

coordinates) using GPS receivers to ensure the main HMD-4 data inputs are georeferenced. For example, the GPS coordinates of core sampling locations will be recorded and used to verify the actual pavement structure to as-built specifications. Data collection teams will be trained on proper use of GPS receiver and to troubleshoot problems that may occur during data collection. The geospatial information will be used to verify and analyze the HMD-4 data (for example, determining homogenous sections). The GIS Expert will use the data to create the GIS database and present the main HDM-4 data inputs graphically on aerial photos and itinerary diagrams.

Safety Procedures

For the collection of field data, the team will take all appropriate safety precautions, including the use of look-outs and manual traffic control, signage, high-visibility clothing for surveyors, coning and markers. O-D surveys will be directed by the police, in close co-ordination with the Evaluation Team, to ensure the safety of both road users and surveyors. O-D surveys will be conducted one direction at a time to ensure safety of the surveyors.

Rounds and Timing

HDM-4 will be run in full once the major data collection exercise is complete. The model will be updated and revised when necessary with updated data, notably when the traffic counts are available. A time lag of one month is probably needed between the completion of survey data processing and obtaining a full set of reliable HDM-4 results.

Data Processing and Quality

It is anticipated that the data collection will be substantially paper-based except for the readings from the BI and the BB which will be downloaded directly to the computer.

The survey supervisors will conduct initial checks and will be responsible for identifying any errors or omissions in data collection so they can be corrected on site. Data entry will follow and the Survey Manager and the Survey Coordinator will ensure that the survey supervisors or surveyors are available to discuss and assist with any problems arising during data entry. Where questions arise, the Survey Manager and the Survey Coordinator will work backwards to identify whether data entry or collection was at fault.

To the extent possible, selected surveyors will continue their employment as data entry staff. This will provide consistency between site and data entry procedure. The resulting input files will be subject to thorough data quality check prior to analysis and, where necessary, returned for re-entry or correction.

The subsequent first run of the HDM-4 analysis will also provide further checks on data. The initial results will be reviewed thoroughly by the Transport Economist to assess whether the results are questionable and working backwards will confirm whether data entry or data collection was faulty.

Varying components of HDM-4 can be used to check for data quality in the case of traffic counts and road roughness. Where results are highly inconsistent or unexpected, references to the original data may be required and, if necessary, the specific items of data will be edited or deleted.

4.2.6 Analysis Plan

HDM-4 Analysis

The Evaluation Team will use HDM-4 for MCC-funded primary roads in each of the alternative approaches outlined. The Evaluation Team will not conduct economic analysis using the HDM-4 for MCC-funded rural roads and periodic maintenance roads.

There is sufficient experience of HDM-4 in Burkina Faso and the dataset used by the MOI will form a useful starting point for the evaluation. While RED was well suited to the pre-Compact analysis, HDM-4 will yield more powerful results as requested by MCC. HDM-4 is also clearly superior to RED in modeling the realized lifespan of the newly paved roads and road deterioration.

HDM-4 produces a considerable amount of output and the user selects what is most appropriate for the particular study. Of greatest importance is the overall, and sectional, measures of economic viability, such as the EIRR, and the NPV. Sensitivity test results will be summarized in the analysis report. The sensitivity tests will primarily focus on testing the data parameters of traffic volumes and traffic growth. Other values can also be tested to reveal their impact on the overall results.

Graphic Presentation of Main HDM-4 Data Inputs

The findings of the individual data collection efforts (IRI, traffic counts, deflection, core sampling results, surface distress, and structural analysis) will be recorded in itinerary diagrams as well as on high-resolution aerial photography. All pre- and post-Compact road conditions available will be documented and shown on the itinerary diagrams for homogeneous sections. A sample itinerary diagram will be developed for MCC review and approval during the inception period and before beginning the work on all of the itinerary diagrams. The team will hire a GIS Expert to assist this process.

Other outputs such as the road condition by section and year (to reveal deterioration), cost inputs by section and year (capital and maintenance) and traffic volumes, by class, section and year will be reported in the final economic analysis report.

4.3 CHALLENGES

4.3.1 Limitations of Interpretation of the Results or Risks to the Study Design

The results of the economic analysis are dependent upon the quality of the data on which it is based. Therefore, satisfactory data collection of each component is of vital importance to producing an accurate economic evaluation. Surveys need to be carried out thoroughly obtaining representative samples of data which are then carefully processed and analyzed.

The single most significant input data to the HDM-4 analysis is the estimates of Annual Average Daily Traffic (AADT). The timing of the traffic counts and their subsequent adjustment determine the estimates of AADT used. Traffic count data are vital to the HDM-4 and the risk of inaccuracy is only reduced by extending the survey period (effectively increasing the sample).

Therefore, the Evaluation Team will fully explore the options before determining the precise timing of the traffic counts and continue the counts for as long as practical to decrease the risk of data inaccuracy. The Evaluation Team will also carefully review the adjustment factors used to take Average Daily Traffic (ADT) to AADT.

A long-term solution to ensuring accurate traffic count is to administer a more intensive program of traffic counting. For example, selected locations can be surveyed quarterly or monthly. Automatic traffic counters can potentially provide continuous count data and nullify the risks associated with the use of short-term counts. Research Area 5 elaborates on this option.

HDM-4 readily conducts sensitivity analyses of its key variables, notably the traffic volume. Sensitivity analyses runs the economic model based on a variety of parameters in which specific or combinations of key variables are adjusted to reveal the impact of the data on the overall ERR. Therefore, the impact of overestimating traffic can be identified from the HDM-4 analysis.

V. EVALUATION DESIGN – RESEARCH AREA 2: POLITICAL ECONOMY ANALYSIS OF ROAD MAINTENANCE

5.1 LITERATURE REVIEW

Ideally, road maintenance funding and planning occurs within the broader context of a well-designed system. Governments must construct roads properly, enforce weight limits, and consider traffic patterns, and there are other issues that can affect road deterioration, such as weather. When these conditions exist, governments can accurately forecast road repair needs, allocate sufficient funds for them, and ensure adequate maintenance. However, numerous incentives can undermine good practice implementation of an efficient road maintenance system.

5.1.1 Challenges to Road Maintenance

One challenge that can interfere with high-quality maintenance is poor **initial road construction.** Road construction procurement can suffer from a lack of transparency and a non-competitive process.[15] Procurement costs are difficult to determine leading to unusually low and high bids. While the former can be a sign of efficiency, it could also signal the use of substandard or inadequate materials. High bids might signal inflated costs or a cautious estimate but can also indicate a lack of transparency in awarding grants. For example, collusion between government agencies and contractors can lead to substandard road construction.[16] When these conditions exist roads are likely to deteriorate quicker than engineering designs suggest and hence lead to higher than anticipated budgets for sufficient road maintenance.

A second challenge to accurately forecast road maintenance needs is properly **enforcing load limits**. Many drivers prefer to overload trucks to save money while road maintenance authorities struggle to provide adequate oversight.[17] In addition, even small bribes can add up to considerable

[15] Booth, David and Frederic Golooba-Mutebi (2009). *The Political Economy of Roads Reform in Uganda*. Working Paper 307. London: Overseas Development Institute.
Mathiesson, Craig. 2016. *The Political Economy of Regional Integration in Africa*. Maastricht: ECDPM
Raballand, Gael, Kate Bridges Monica Beuran, and Audrey Sacks (2013). *Does the Semi-Autonomous Agency Model Function in a Low-Governance Environment? The Case of the Road Development Agency in Zambia*. Policy Research Working Paper Series 6585. Washington, DC: The World Bank.
[16] Klopp, Jacqueline. 2011. "Towards a Political Economy of Transportation Policy and Practice in Nairobi." *Urban Forum.*
[17] Hartmann, Olivier and Ephrem Asebe. 2013. *Road Transport in East Africa*. Washington, DC: The World Bank/sub-Saharan Africa Transport Policy Program.

sums on roads with considerable traffic. For these reasons, allowing overloaded trucks contingent on a small bribe can appeal to those in charge of enforcing road limits.[18]

Even if governments construct high-quality initial roads, develop repair plans that accurately reflect anticipated road deterioration, and ensure compliance with weight restrictions, road maintenance agencies may struggle to gain sufficient **funding** for repairs.[19] Connecting a new community to a feeder road or replacing an earth or gravel one with a tarmac road has enormous beneficial consequences for isolated communities. As a result, any politicians prioritize new road construction over road repairs.[20] In addition, political interference can lead to steering funds away from the highest maintenance priority to their most exigent political priority.

Finally, the same types of collusion and/or lax oversight that leads to poor initial road construction can also lead to substandard **road maintenance activities**. When these conditions exist, newly-repaired roads will deteriorate more quickly than engineering plans forecast.

Ensuring proper road maintenance is a political economy challenge. To transform a dysfunctional road maintenance system into an efficient one requires far more than capacity building for employees of road maintenance agencies and firms, and/or the creation of independent road agencies. Independent road maintenance agencies, in particular, are often a proposed solution to the challenges discussed in this section. However, poor enforcement can often lead to a large gap between a *de jure* independent road maintenance agency and a *de facto* one.[21] Rather, creating an efficient road maintenance system requires realigning individual and/or political incentives towards effective high-quality road construction and repairs, enforcement of weight limits, and ensuring proper allocation of funds for road repair.

---

[18] Hoffman, Barak and George Kidenda. 2014. "Political Economy of the Transport Sector Integration in the East African Community." In Brenton and Hoffman, eds. *The Political Economy of Regional Integration in sub-Saharan Africa.* Washington, DC: The World Bank.

[19] Booth, David and Frederic Golooba-Mutebi 2009. *The Political Economy of Roads Reform in Uganda*. Working Paper 307. London: Overseas Development Institute.

Africa. Washington, DC: The World Bank.

Raballand, Gael, Kate Bridges Monica Beuran, and Audrey Sacks. 2013. *Does the Semi-Autonomous Agency Model Function in a Low-Governance Environment?*

[20] Booth, David and Frederic Golooba-Mutebi (2009). *The Political Economy of Roads Reform in Uganda*. Working Paper 307. London: Overseas Development Institute.

Briggs, Ryan. "Aiding and Abetting: Project Aid and Ethnic Politics in Kenya." *World Development* 64: 194–205.

Burgess, Robin, Remi Jedwab, Edward Miguel and Ameet Morjaria. 2010. *Ethnicity Meets Politics: One Hundred Years of Road Building in Kenya.* Oxford: Center for Studies of African Economies.

Burgess, Robin, Remi Jedwab, Edward Miguel, and Ameet Morjaria. 2010. *Our Turn to Eat: The Political Economy of Roads in Kenya*. Oxford: Center for Studies of African Economies.

Hoffman, Barak and George Kidenda. 2014. "Political Economy of the Transport Sector Integration in the East African Community." In Brenton and Hoffman, eds. *The Political Economy of Regional Integration in sub-Saharan*

Raballand, Gael, Kate Bridges Monica Beuran, and Audrey Sacks (2013). *Does the Semi-Autonomous Agency Model Function in a Low-Governance Environment? The Case of the Road Development Agency in Zambia*. Policy Research Working Paper Series 6585. Washington, DC: The World Bank.

[21] Mathiesson, Craig. 2016. *The Political Economy of Regional Integration in Africa*. Maastricht: ECDPM

Raballand, Gael, Kate Bridges Monica Beuran, and Audrey Sacks (2013). *Does the Semi-Autonomous Agency Model Function in a Low-Governance Environment?*

Raballand, Gael, Kate Bridges Monica Beuran, and Audrey Sacks. 2013. *Does the Semi-Autonomous Agency Model Function in a Low-Governance Environment?*

There are few studies on political economy challenges to road maintenance in Burkina Faso. The literature that does exist tends to place it within the broader challenges of the transport sector in West Africa. Two findings that emerge from these studies are that (1) transport prices are higher in West Africa than other parts of the continent due to weak competition in the transport industry[22]; and (2) landlocked countries in the region suffer much higher prices than coastal ones due to high logistics costs and long delays for cargo due to lengthy border procedures[23].

5.1.2 Formal and Informal Institutions of Road Maintenance

Formal and informal institutions cover *de facto* and *de jure* processes for decision making. The former focuses on legal and regulatory systems, while the latter examines actual processes. An analysis of formal and informal institutions examines issues such as structures and norms of power and how they influence action by various stakeholders; the quality of governance; the divergence between formal laws/procedures and the way the government and private sector operate in practice; and how these factors affect policy-making and implementation.

5.2 EVALUATION QUESTIONS[24]

1) **How does road maintenance occur in Burkina Faso? Do informal processes diverge from formal ones?**
    a. How have procedures for road maintenance changed since the new government has come into power and/or MCC's program ended?
    b. What are the procedures for awarding contracts for road maintenance activities? Are bids open and assessments transparent? How do actual processes differ from official ones?
    c. What type of oversight does the MTMUSR undertake for road maintenance? How does it ensure accountability for the funds it allocates to AGETIB?
    d. How do regulations and processes (formal and informal) for road maintenance in Burkina Faso compare to regional/international standards or best practices?

The purpose of this question is to understand the extent to which actual processes for road maintenance diverged from the formal ones outlined in GoBF laws and regulations. For example, do processes for awarding contracts for road maintenance follow existing rules and regulations or is corruption common?

2) **Who are the main stakeholders for road maintenance? What are their interests and powers?**
    a. Why has the MTMUSR consistently rejected the budget request from FER-B since 2015? Are there any signs budget allocations will rise over the next few years?
    b. Why is Burkina Faso Special Road Fund (*Fonds Spécial Routier du Burkina Faso*, FSRB) unable to secure funds from the fuel levy and tolls for road maintenance?

---

[22] Raballand, Gael and Supee Teravaninthorn. 2009. *Transport Costs and Prices in Africa.* Washington, DC: The World Bank.

[23] Arvis, Jean Francois, Gael Raballand, and Jean-Francois Marteau. *The Cost of Being Landlocked.* Washington, DC: The World Bank.
Zerelli, Sadok and Andy Cook. 2010. *Trucking to West Africa's Landlocked Countries.* West Africa Trade Hub Technical Report #32. Washington, DC: USAID.

[24] The Evaluation Team added sub-questions to the main questions based on the initial observations from the second trip.

c. Do FSRB records accurately classifying construction and maintenance activities?
d. Who is against making FSRB more autonomous and why? Does FSRB have any supporters in government in favor of granting it more autonomy?
e. In what ways do procedures for road maintenance fall short of the African Development Bank's standards for budget support for this activity? Is the MTMUSR attempting to address any of the issues they raise? Which ones are they addressing and why?
f. Why does overloading remain pervasive? Is it a result of petty corruption on the roads or higher-level pressure from government and/or transporters?
g. Are there signs that powerful private sector interests are emerging in favor of higher-quality road maintenance?

Political economy analysis, in part, seeks to identify the key stakeholders around issues, determine their power and incentives, and comprehend the formal rules and informal norms that determine decision making processes. This will allow us to assess relative power among stakeholders in road maintenance, and link decisions in this area to variation in the interests and influence of sector stakeholders.

3) To what extent did MCC achieve the intended outcomes of the Incentive Matching Fund for Periodic Road Maintenance? Why or why not?

a. How much funding has the GoBF allocated to road maintenance since the end of the Roads Project? What factors have influenced the funding level for road maintenance over this period?
b. Did MCC's efforts to secure commitments from other development partners to continue the matching fund succeed? Have other development partners shown interest in supporting programs to improve road maintenance?
c. What actions could MCC have taken to increase the likelihood that road maintenance would be sustained?
d. Should MCC's future investments in roads include support to maintenance regimes?

One of the main objectives of the MCC Burkina Faso Roads Project is to increase the amount of funds the GoBF allocates to road maintenance. The purpose of this question is to examine whether this has or has not occurred and the reasons for the change and/or lack of change.

4) Did the capacity building activities MCC supported cause the government to improve road maintenance? Did these changes remain after MCC support ended?

a. How many road maintenance staff trained by MCC remain in the MTMUSR and AGETIB? Are they applying what they learned? Did those skills effect these organizations' road maintenance activities?
b. How did MCC's assistance help FER-B perform effective oversight over AGETIB? Are they still employing these practices?

Another main objective of the MCC Burkina Faso Roads Project is to improve the quality road maintenance through building the capacity of relevant government authorities in this area. The purpose of this question is to examine whether this has or has not occurred and the reasons for the change and/or lack of change.

5) Have there been any changes to the planning, financing, and implementation process of road maintenance following MCC's assistance?

a. Did MCC's assistance help FER-B design plans for road maintenance?
b. Did MCC's assistance help FER-B design financial plans for road maintenance?

The purpose of this question is to examine whether there have been any beneficial impacts from the MCC Roads Project on processes for planning, determining financial needs, and/or processes for implementing road maintenance activities. These are some of the higher-level objectives of the MCC Roads Project in Burkina Faso.

5.3 EVALUATION APPROACH

5.3.1 Existing Data

Post-Compact Restructuring of FER-B

The Evaluation Team met with the General Directorate and the Administration and Finance Director of the FER-B. The team was informed that the FER-B, which existed throughout the implementation period of the Compact, had been restructured in February 2016 by a ministry council decree. The intention was to transform FER-B into a second-generation road maintenance fund. The new organization is called Burkina Faso Special Road Fund (*Fonds Spécial Routier du Burkina Faso,* FSRB).

The evaluation team received scanned files of (1) a copy of the decree, and copies of other important documents such as (2) the five-year strategic maintenance plan; (3) copies of the contracts with the central government and RDs of the MOI for the traffic counts and the measurement of the IRI; (4) a copy of the contract with AGETIB, the agency in charge of the management of the periodic maintenance works funded by the IMFPM and by the Government; and (5) the maintenance budgets of the last three years.

The General Director informed the team that after the close of the Compact, the government had asked the development partners (DPs) to fund periodic maintenance. Apparently, the response was negative because the FER-B had not been transformed into a second-generation road fund as the DPs had been recommending since 2007. This was the deciding factor in the transformation of FER-B into FSRB. Usually second-generation road funds are created by law rather than by decree, because a law is more difficult to change than a decree. According to the General Director, the government was effectively thinking about voting into law the creation of the FSRB.

Yet, the set-up of the funding of the FSRB is not complete. A second-generation road fund usually receives most of its income from fuel taxes and road tolls, and these taxes and tolls go directly to the road fund, so that there is a steady stream of income. However, currently in Burkina Faso, these taxes and tolls still go directly to the Treasury as before when the FER-B was in charge of maintenance. In Burkina Faso, the taxes on petrol products are 150 F CFA per liter of gas and 50 F CFA per liter of gasoil. The total amounts given to the road fund were as follows:

- In 2015: 15 billion F CFA
- In 2016: 20 billion F CFA

However, FRSB estimates that about 60 billion F CFA per year is needed to fund routine and periodic maintenance.

The GoBF votes each year on a budget that is then given to the FSRB. This can lead to major fluctuations in the income of the road fund. For example, due to the political unrest in October

2014, there was no budget made available for periodic maintenance in 2015 and funds for 2016 were made available very late. This is not a satisfactory set-up but according to the General Director the government intends to change this.

A major change in the FSRB is that the GoBF combined maintenance and new road construction fund as FSRB. In principle, it is not problematic to combine both in one road fund and can be an advantage in ensuring an appropriate balance between construction and maintenance budget. Yet this approach only is effective if there is a complete financial separation between the construction arm and the maintenance arm. Fuel taxes and user fees would fund maintenance, while general government revenue and DPs would fund construction. However, because FSRB to date has not separated these expenditures accurately, many of its periodic maintenance contracts were, in reality, for construction. As a result, the low levels of official maintenance expenditures since 2015 exaggerate the actual level of it.

The decree creating the FSRB also allows it to diversify its sources of funding: in addition to funds from taxes and tolls and grants from DPs, the FSRB would be allowed to tap into national and international money markets with a guarantee by the state.

The General Director informed the Evaluation Team that the FSRB funds not only the maintenance works and the related management, design and supervision contracts, but also the maintenance planning. This means that the FSRB funds either regional and central directions of road administration through conventions to allow them to achieve traffic and roughness measurements surveys (estimated at more than 1.6 million F CFA per year).

Burkina Faso Infrastructure Works Agency (AGETIB)

According to the DG, during the implementation of the IMFPM of the Compact, it was agreed between the GoBF and MCC that the AGETIB would be contracted to do the management of the periodic maintenance works. The management of periodic maintenance was funded by the MCC IMFPM and the Government. The AGETIB was paid 5 percent of the cost of the works as a management fee. Supervision contracts were given to DGER who received a supervision fee of 4 percent.

The Evaluation Team also met with the General Director and the staff of AGETIB. AGETIB was created as a road agency by the government in 2010 and became operational in 2012. While their status is that of a state-owned company, AGETIB is managed as a private company. They confirmed that as the IMFPM contracting authority representative of FSRB, AGETIB has been in charge of approximately 700 km of periodic maintenance funded by MCC or the Government.

The contracts for conducting period maintenance were somewhat different between the MCC funded and the government funded maintenance. The MCC funded periodic maintenance contracts were free of taxes and included some specific socio-environmental requirements. The contracts financed by the government were fully taxed with less socio-environmental requirements. The discrepancy may have induced some cost differences for the two types of periodic maintenance funding.

Initial Observations

The IMFPM mechanism produced the initial intended result as the Government made funds available for periodic maintenance. In total, during the last two years of the Compact, over 600 km of periodic maintenance were funded half by the IMFPM and half by the Government. This is an important improvement over the previous years. Also, according to the FSRB, the GoBF is

now convinced of the importance of periodic maintenance and the five-year maintenance plan is designed to catch up with the backlog of periodic maintenance. Unfortunately, the political unrest of October 2014 has resulted in no periodic maintenance in 2015 and in 2016. It remains to be seen whether the reforms will be completed and will be effectively implemented in a sustainable way.

There is also evidence that the GoBF systems may fall short of standards development partners for undertaking road maintenance. For instance, the African Development Bank (AfDB) rejected a budget support request for road maintenance. According to transport specialists in the AfDB's Ouagadougou's office, AfDB rejected the request because existing government systems do not meet the AfDB's transparency and accountability standards for transport sector budget support.

5.3.2 Methodology

To adequately address Research Area 2, the combined skills of 1) comparative political economy, 2) local expertise on politics in Burkina Faso, especially in government planning and/or in the transport sector, and 3) technical engineering road maintenance are required.

The Political Economist, Barak Hoffman, will guide the research by developing a detailed set of questions, identifying key stakeholders to interview, and determining the data to collect. The Political Economist, will mainly collect information for Research Area 2 by conducting key informant interviews (KIIs). The initial list of stakeholders to interview is listed below in Table 5.1. We will supplement information from interviews, to the extent possible, with existing documents as well as data (e.g., costs of road construction, prevalence of overloading).

Local expertise is especially important given the large amount of information and substantial areas of detail Research Area 2 covers. The Political Economist will also be responsible for the overall analysis while the local Transport Expert, Hippolyte Lingani, will assist the team gathering of the data and information with his local expertise.

The Team Leader, with extensive expertise on road maintenance, will assist understanding the maintenance status of the MCC-funded periodic maintenance roads. Other team members including the Senior Pavement Engineer and the Transport Economist will support the Team Leader in this process. Engineering data collection for the periodic maintenance roads will occur under the data collection for Research Area 1 (see Table 4.2 for more detail). The team will conduct 1) road roughness survey and 2) surface distress survey to determine the road conditions of the periodic maintenance roads.

5.3.3 Data Collection

In preparation of the Evaluation Design Report, the team collected a number of documents from various sources and will continue to collect additional documents to address evaluation questions under Research Area 2.

Instrument

Research Area 2 will utilize information collected from Research Area 1 on maintenance condition of periodic maintenance roads. Under Research Area 1, the Evaluation Team will conduct road roughness surveys and surface distress surveys on the MCC-funded periodic maintenance roads. For the road roughness survey, the Evaluation Team will collect IRI using survey vehicles equipped with calibrated BI on periodic maintenance road sections in both directions every 500m. The results will be processed and analyzed to provide average roughness per homogeneous traffic

section. Roche collected IRI on the periodic maintenance roads in 2014-15 and the team will repeat these IRI measurements to examine changes in the IRI. The IRI will be measures using vehicle-mounted BI.

Under Research Area 1, the team will also conduct surface distress survey by driving over the surveyed periodic maintenance roads and classifying the surface distress as good, fair, poor, or bad for each road sections, focusing on areas of visible distress. In addition, any areas of evident deterioration will be noted.

The main qualitative instrument the Evaluation Team intends to employ for Research Area 2, that cannot be obtained through existing documents, are KIIs with stakeholders. A list of illustrative stakeholders for KII is below in Table 5.1. The team will conduct semi-structured interviews, a fairly open framework which allow for focused, conversational, two-way communication. Semi-structured interviews ensure that consistent data is collected yet the individual's perspective about the relative importance of any factor is allowed to come through. The team will ask questions based on the six evaluation questions described above. Relevant follow-up questions will be asked by the team to obtain more specific information, such as examples of informal road maintenance processes diverging from formal ones and specific impacts of the MCC Roads Project on road maintenance activities.

Sample

For qualitative data collection, the team will conduct structured KIIs with the main stakeholders in greater detail than the preliminary meetings. The Evaluation Team already held a number of preliminary meetings with the key stakeholders. The main stakeholders relevant to road maintenance will be in the public sector, private sector, civil society, and international organizations. The list of stakeholders to be interviewed is as follows. The list below is preliminary and a limited number of additional stakeholders may be added during the data collection phase.

Table 5.1 List of Illustrative Stakeholders for KIIs

Type/Organization	Position Title
Ministry of Transport, Urban Mobility, and Road Security (MTMUSR)	Secretary General
	General Directorate of Land and Sea Transport (DGTTM)
	General Directorate of Sector Work and Statistics (DGESS)
Ministry of Economy, Finance, and Development (MEFD)	Representative
Ministry of Infrastructure (MOI)	General Directorate of Roads Maintenance (DGER)
	General Directorate of Rural Roads (DGPR)
	General Directorate of Burkina Faso Special Road Fund (FSRB)
	General Directorate of Standardization, Engineering Studies and Control (DGNETC)
Burkina Faso Infrastructure Works Agency	General Directorate
Burkina Shippers Council (CBC)	Director
	Author of the Transport Cost Study

Type/Organization	Position Title
Chamber of Commerce	Representative
Burkina Faso Organization of Transporters (OTRAF)	President
	Secretary General
	Regional representatives in Ouagadougou, Koudougou, Bobo-Dioulasso
Development Partners	World Bank
	African Development Bank
	European Union
	USAID West Africa Trade and Investment Hub representative (representation in Ouagadougou or main office in Accra)
Regional organizations	Francophone West African Economic and Monetary Union (*Union Economique et Monétaire Quest-Africaine*, UEMOA)
	Economic Community of West African States (ECOWAS)
Association of Cotton Producers (SOFITEX)	Representative
National Petroleum Company (SONABHY)	Representative
A large cement factory	Representative (for example Diamond Cement in Ouagadougou)

Rounds and Timing

Given the similarity in procedure and scope, the technical engineering data collection on the periodic maintenance roads – road roughness survey and surface distress survey – will occur in parallel with data collection for other Research Area 1.

KIIs for Research Area 2 will occur in the fall of 2017. It is best to wait until the GoBF passes its budget for the next fiscal year as it may lead to an increase in road maintenance activities as compared to recent years and therefore allow the Evaluation Team to observe a greater volume of road maintenance activities.

Staffing

Eddy Bynens, the Team Leader, working closely with the Senior Pavement Engineer and the Transport Economist, will support the analysis and management of engineering data on the periodic maintenance roads for Research Area 2. The road roughness surveys will be conducted by teams of four, including driver – maximum of three teams, led by the Senior Pavement Engineer and the surface distress surveys will be conducted by teams of two, a driver and the Senior Pavement Engineer.

The Evaluation Team anticipates the qualitative data collection and analysis to be completed by the Political Economist, Barak Hoffman, and the local Transport Economist, Hippolyte Lingani.

Data Processing and Quality

Road engineering data for the periodic maintenance road will be processed with Research Area 1 to maintain high quality and consistency across different road types (refer to Section 4.2.5 of this document for more details).

For the qualitative data, when the team is unable to obtain highly relevant documents in English, the French document (or at least the executive summary) will be translated for the purpose of the evaluation. The team will conduct KIIs in French with the assistance from an interpreter as needed and in English whenever possible. Meeting notes will be drafted in French and/or in English, as necessary.

5.3.4 Analysis Plan

The team will mainly employ USAID Applied Political Economy Analysis Field Guide for the analysis[25]. This occurs through three levels:

1. ***Defining the Sector:*** This requires identifying key actors in a sector and the nature of the relationship between them. Above, we identified our preliminary lists of key actors in road maintenance in Burkina Faso. This list will likely evolve and become more specific as we conduct the interviews.
2. ***Assessing Sectoral Implementation Capacity:*** This level of analysis examines how economic, political, and/or and social factors influence the capacity of government officials to implement policies. It focuses on issues such as budgetary allocations, staff levels and salaries, as well as accountability of government officials.
3. ***Identify Constraints and Opportunities for Reform:*** After understanding the sector and assessing policy implementation capacity, the analysis determines constraints and opportunities for reform. It seeks to answer questions such as: Who would block reforms and why? Is it possible to build a coalition for reform among concerned stakeholders? Are capacity constraints in some government agencies due to lack of funds or government disinterest in the sector? Are there areas in need of support that the government and other cooperating partners have ignored?

The road engineering data for the periodic maintenance road will be analyzed in accordance with other data analysis under Research Area 1 to maintain high quality and consistency across different road types. The IRI measurements will be compared to the measurements collected in 2014-15 by to examine changes in the IRI.

5.4 CHALLENGES

5.4.1 Limitations of Interpretation of the Results or Risks to the Study Design

Political Economy analyses can offer useful insights but also have a number of important limitations:

First, understanding an issue does not imply that MCC (or any other DP) can influence it. For example, if tolerance for corruption at high levels of government is part of a country's elite

[25] USAID's Applied Political Economy Analysis Field Guide provides a clear framework of problem-driven political economy analysis. For an example please see: USAID. 2016. *USAID Applied Political Economy Analysis (PEA) Field Guide.* Washington, DC: USAID.

settlement26 or social polarization has deep historical roots, external development partners may face severe limits in being able to ameliorate these problems. A political economy analysis cannot necessarily provide solutions to weaknesses in governance or resolve political/social tensions in a country.

Second, stakeholders often have a strong incentive to hide their nefarious activities, such as corruption. Consequently, are likely to encounter difficulties in probing and fully understanding these issues, as well as ascertaining the true interests of people engaged in these activities. For example, determining that a government agency colluded with a private firm to win certain bids requires documentation of their activities. Such evidence is often difficult, if not dangerous, to obtain.

Third, while political economy analysis can provide insight into decision making processes around key issues in a country, it cannot promise a single, objective account of all problems. In many cases, especially in countries that have deep political or social cleavages, there may not be a single, objective truth to uncover. Rather, there may be multiple versions of the truth by various stakeholders. Political economy analysis can document these competing claims but may not be able to adjudicate them. Even when it can do the latter, that does not mean it is possible to change perceptions among parties to a conflict.

VI. EVALUATION DESIGN – RESEARCH AREA 3: STUDY OF ROAD USERS

6.1 EVALUATION QUESTIONS

1) **What is the origin and destination of goods and people traveling along MCC-funded roads?**

The origins and destinations of traffic are among the most important traffic characteristics and they provide a basis of understanding travel demand and road infrastructure needs. Insight on the origin and destination of road users and goods transported will provide a comprehensive picture of the trip patterns and travel choices of the road users on MCC-funded roads.

2) **What are the predominant reasons for use of the MCC-funded roads? And what is the balance between work/business and non-work journeys?**
    a. What, if any, noticeable changes have occurred in the reasons for use of the MCC-funded roads? And if so, why did the changes occur?

The evaluation questions above attempt to identify who is using the MCC-funded roads and why. It is important to know not only the number of road users but also the reasons why they are using these roads. This evaluation question will also attempt to reveal whether the reasons for using the MCC-funded roads have changed to any significant degree as a result of the Compact investment and, if so, why that may be the case.

[26]Elite settlements are broad compromises among rival elite factions that provide the foundation for political stability. For more insight, see: Burton, Michael and John Higley. 1987. *Elite Settlements*. American Sociological Review 52 (3): 295-307.

3) **How much are road users paying for their trips and how has this changed since road improvement?**

It is reasonable to assume that travel costs have significantly reduced following completion of the Roads Project. The evaluation will examine if the reduction in VOCs triggered greater use of the roads by motorists or public transport users. The study will also identify who have been the main beneficiaries of this reduction in travel costs.

6.2 EVALUATION APPROACH

6.2.1 Existing Data

Structure and Content

The O-D surveys carried out as part of the Burkina Faso Roads Project mid-Compact in October 2012, prior to road improvement, was designed to include the following items of information:

- Location/date/surveyor/hour
- Vehicle type
- Vehicle ownership
- Vehicle nationality
- Origin
- Destination
- Vehicle occupancy
- Journey purpose
- Journey frequency
- Type and tonnage of goods transported

The coding guide for surveyors listed five types of vehicle ownership:

- Private (personal)
- Government
- Non-Governmental Organization (NGO)
- Private (commercial)
- Other

Eight classes of nationality are listed, including Burkina Faso and "other". Seven journey purposes were listed as below:

- Work
- Business/Market
- Ceremonies
- Family
- Leisure
- Tourism
- Other

Scope

O-D surveys were conducted at 11 stations. In total, 5,430 roadside interviews were conducted over a period of eight days. The most study-specific component is the zone coding which

represents the road(s) being studied and the objectives of the study. Coding for origin and destination responses covered 12 zones in total, five internal plus seven external to Burkina Faso.

Limitations

While the survey was designed to collect more information, the O-D data collected from 2012 is incomplete because only information on location, date, vehicle type, owner type, origin and destination is available. This is sufficient to give an initial indication of traffic movements and journeys made at the time of the survey. However, it falls short of the intended scope of the survey and lacks critical information, such as vehicle occupancy and journey purpose, which is very useful for broader transport planning and economic evaluation. In addition, it is still not clear to what extent the collected data has been processed, analyzed, and applied. The format of the survey instrument is, in general, acceptable and should prove useful for the new O-D survey.

6.2.2 Methodology

Input to HDM-4 Economic Analysis

O-D survey data examines how goods and people travel along roads, where they are going, and the motivations for the journey. The O-D data forms an input for the HDM-4 economic model to calculate the benefits of MCC's Roads Project. New O-D data are required for the evaluation, particularly given that the data from those surveys carried out during the Compact were not obtained in full (details of O-D survey conducted in 2012 are discussed below).

In terms of connectivity with the economic evaluation the most important components of the O-D survey are the following (classified by vehicle type):

- Vehicle occupancy
- Journey purpose (particularly the work/ non-work split)
- Type and tonnage of goods transported

Additional Study-Specific Data

In addition to the information needed for the HDM-4 analysis, the survey will collect information on where people or goods travel to/from and why, how much they are paying for their trip, how long the trips are on average, and what the type/quantity/value of goods that are being transported. This will allow stakeholders to understand travel patterns and measure trends in travel demand. The O-D data will provide an overview of how the road is currently being used and allow comparison with the baseline O-D data as appropriate.

The vehicle intercept surveys will be conducted in parallel with one-to-one interviews with public transport users at major bus stations, for example Kedougou, on the MCC-funded project roads. Such interviews will identify what journeys individual public transport users are making, their reasons for making the journeys, and the costs of the journeys. In particular, trends in journey costs, before and after MCC investment, can be revealed. The agreement of the bus station authorities is required for this component of the surveys.

Additionally, consideration will be given to covering "indirect road users" such as the hirers of road freight services. The evaluation will examine how the improved roads affected road freight service costs and their usage of haulage services. This element of data collection intersects with Research Area 4 and it is compatible with the O-D survey.

6.2.3 Data Collection

Instrument

The survey form used in the O-D surveys in 2012 forms a good basis for fresh surveys. The journey purpose options will be revised, particularly because the distinction between journeys in work time and in non-work time is not clearly distinguished. It may be counterproductive to increase the number of questions because the response rate of the road users may correspondingly be reduced.

The O-D surveys will be augmented by interviews with public transport users at bus stations on the MCC-funded primary roads. The public transport user surveys, if possible, be conducted on the same days as the vehicle intercept survey. The number of public transport user interviews will reflect the balance of road use with motorists. An appropriate ratio would be broadly in line with usage of the road being surveyed, so that the balance between O-D interviews and public transport user interviewers would reflect the ratio between motorists and bus/minibus passengers currently using the road. The ratio will be apparent during the course of the O-D surveys. Therefore, the interviews with public transport users will need to be sufficiently flexible to allow for this.

Consideration will be given to surveying the users of goods transport services to provide a fuller picture of the users and beneficiaries of the MCC-funded roads (this overlaps with Research Area 4).

Illustrative survey forms for the vehicle intercept survey and public transport user interview are in Annex 1.

Sample

O-D surveys will be carried out on each of the three MCC-funded primary roads, using surveyors provided by, or recommended by, the MOI regional directorates. The list of illustrative O-D survey locations is presented below. A minimum of one survey will be conducted for each MCC-funded primary road at locations below marked as "Standard Approach" in Table 6.1 (O-D Survey Number 1, 3, and 5).[27] Further discussion with the RDs will assist in identifying suitable station. Police posts, weigh stations, and toll stations have the appropriate layout to conduct the survey but they will require official approval.

Table 6.1 Origin-Destination Survey Locations

O-D Survey Number	Road No.		RA 1 Approach	Section Location		Notes
	Official	Study		from	to	
1	RN14	1	Standard	Dedougou	Biran-Bobo crossroads	Outside Dedougou
2	RN14	1	Comprehensive	Nouna	Djibasso	
3	RR21	2	Standard	Banfora	Toumusseni	At a weigh station
4	RR21	2	Comprehensive	Douna	Sindou	
5	RN21	3	Standard	Koudougou	Reo	At a police post
6	RN21	3	Comprehensive	Sabou	Koudougou	

Rounds and Timing

[27] The Evaluation Team presented two options, either one or two surveys per primary road, in Chapter 4.

Survey duration will be a minimum of two days per traffic direction and 12-hour duration.[28] For safety, the team will not survey both directions simultaneously. Given that the surveyed roads are lightly trafficked, the sample rate of interviewed vehicles will be at minimum 20 percent (one interview out of every five vehicles).[29] The Evaluation Team does not expect difficulty achieving a 20 percent sample rate. The accompanying counts will confirm the actual rates of response.

The MOI at the RD level has experience carrying out O-D surveys and this will be valuable in the planning of the surveys. The Evaluation Team will also contact the police early to ensure their timely cooperation.

Staffing

Care will be taken in the recruitment of survey staff to ensure that the process is equitable and provides the most capable and professional surveyors. The team will take into consideration surveyor with previous experience working with the MOI on their O-D surveys. The traffic survey supervisor will assist in the selection and subsequent training of staff; it is important that survey staff interact with road users in a professional and courteous manner. Roadside interviewers will be trained to be both polite and efficient, the interview being solely for the collection of information relating to the journey being made.

O-D surveys will consist of teams of six persons with one supervisor. The RD will form the first port of call in recruiting staff. The staff for the O-D surveys will be selected from the most capable and personable traffic counters available and maintain gender-neutrality.

Public transport user surveys will consist of teams of four persons with one supervisor. In terms of capability, staffs will be of equivalent standard to the O-D surveyors. The recruitment of survey staff will be confirmed following the second field mission and in agreement with MCC. The precise number of survey teams for each survey will be determined when the complete survey program is confirmed in consultation with MCC and local stakeholders.

Data Processing and Quality

The survey supervisors will conduct initial checks and will be responsible for identifying any errors or omissions in data collection so they can be corrected on site. Data entry will follow and the Evaluation Team will ensure that the survey supervisors or surveyors are available to discuss and assist with any problems arising during data entry. To the extent possible, selected surveyors will continue their employment as data entry staff; this will provide consistency between site and data entry procedure. The resulting input files will be subject to a thorough data quality check prior to analysis and, where necessary, returned for re-inputting or correction.

The subsequent analysis will also provide further checks, both through the software used to analyze the data, for example Excel. The team will identify where initial results are questionable and working backwards will confirm whether data entry or data collection was faulty.

6.2.4 Analysis Plan

The data collected from the O-D surveys will be entered into Excel for data processing and analysis. The Transport Economist/Modeling Expert will lead the analysis process of the O-D surveys. Data collected will be disaggregated by gender, age, and other social differences and

[28] The Evaluation Team presented two options, either two or three-day survey per primary road, in Chapter 4.
[29] The Evaluation Team presented two options, either a minimum sample rate of 20 or 25 percent, in Chapter 4.

analyzed to see if any significant differences exist between them among the MCC-funded road users and the public transport users.

In the absence of comprehensive baseline, the comparison between pre- and post-Compact O-D data will pertain to available data only. In addition, interviews will attempt to reveal individual user's changed perceptions of and usage of the study roads as a result of MCC investment.

The findings of the individual data collection efforts will be recorded in itinerary diagrams as well as on high-resolution aerial photography. All pre- and post-Compact road conditions available will be documented and shown on the itinerary diagrams. A sample itinerary diagram shall be developed for MCC review and approval during the inception period and before beginning the work on all of the itinerary diagrams. The team will hire a GIS Expert to assist this process.

6.3 CHALLENGES

6.3.1 Limitations of Interpretation of the Results or Risks to the Study Design

Road user study results are dependent upon the quality of the data. Therefore, the O-D surveys need to be carried out thoroughly, obtaining representative samples of data which will be then carefully processed and analyzed.

The single most significant limitation and risk of the collected data is that of either insufficient or unrepresentative samples. Inevitably, the data collected will form a sample of the usage of the project roads. Care will be taken to ensure that as much as possible the samples obtained are both sufficient in size, dictated by duration of survey and sample rate, and representative of usage of the roads being surveyed. O-D surveys by their nature provide short-term snapshots of road usage and representativeness can be difficult to assess. However, the limitations and risks can be mitigated through maximizing practical duration and sample size, conducting surveys at complementary (and possibly overlapping) locations, a thorough set of interview questions including frequency of trip, and simultaneous traffic counts which are extended beyond O-D survey hours.

As an input to the economic analysis, the risk of limited O-D data affecting the overall quality of the HDM-4 model is relatively low.

VII. EVALUATION DESIGN – RESEARCH AREA 4: STUDY OF TRANSPORT MARKET STRUCTURE

7.1 LITERATURE REVIEW

According to the Trade Hub Technical Report No. 32, prepared for USAID in September 2010, titled "Trucking to West Africa's Landlocked Countries: Market Structure and Conduct"[30], Sahelian landlocked countries — Mali, Burkina Faso, and Niger — suffer from high costs of road haulage. The main drivers of the high costs are long distances to ports, poor road conditions, un-roadworthy trucks, poor logistics, and corruption. High costs of road transport often limit the

[30] Dr. Sadok and Dr. Andy Cook, -Trucking to West Africa's Landlocked Countries: Market Structure and Conduct, Trade Hub Technical Report No. 32, September 2010, 69 pp.

competitiveness of transit trade through West Africa's ports. The resulting low volumes of trade also hinder Sahelian countries' prospects for economic development and thus restrict growth in employment and incomes.

A World Bank report by Teravaninthorn and Raballand (T&R), "Transport Prices and Costs in Africa: A Review of the Main International Corridors"[31], predicts a similar picture. The authors find that the transport of freight between Sahelian countries and their ports features prices that are significantly higher than the underlying costs. This finding suggests that large profits are funneled to rent-seeking road-transport cartels benefitting from oligopolies. T&R argue that unless the governments take steps to remove the structural distortions of the trucking market, there is no point in investing to reduce road-transport costs. The authors claim that the cartels will capture the benefits from lowered costs while the prices will remain the same for the users. If true, this represents a fundamental constraint to the economic development for the three poorest and landlocked countries in West Africa – Burkina Faso, Mali, and Niger[32].

In particular, the World Bank report suggests that the most effective measures to reduce transport costs in West and Central Africa are: (1) decreasing fuel costs, (2) improving road conditions, and to a lesser extent, (3) reducing delays of border-crossing. The analysis shows that reducing fuel prices by 20 percent and improving road conditions from fair to good could lead to reductions in transport costs by 9 percent and 5 percent, respectively. Reducing delays of border-crossing by 20 percent would have a marginal impact on transport costs.

However, such substantial reductions in transport costs would not necessarily lead to any reduction in transport prices because transport markets are strongly regulated in these regions. Therefore, the report suggests that any intervention should first aim to reform cartels. Breaking the regulatory status quo in any country is difficult due to a coalition of interest groups against changes. The corridors often are the main, and sometimes the only, transport mode for international and domestic trade for a number of countries. Therefore, truckers have a strong leverage against high-level authorities. Furthermore, some of these authorities personally own or indirectly control trucks or trucking companies and therefore benefit from the status quo and current market-sharing schemes. Deregulating the trucking industry in West and Central Africa is less a technical than a political and social issue.

In contrast, in a recent paper dated October 2014, "Political Economy of Transport Sector Integration in the East African Community" [33] by Barak Hoffman and George Kidenda, the authors find that transport infrastructure in East Africa Community (EAC) member states has improved dramatically over the past two decades. Among the more notable achievements are (1) vast improvements in the quality of the region's trunk roads, (2) substantial reductions in road travel times, (3) growing compliance with vehicle weight restrictions, and (4) falling transport prices due to the aforementioned changes, mainly along the Northern Corridor.

This study elucidates the political economy factors that supported these improvements. The findings are largely consistent with recent literature on the political economy of regional

[31] Supee Teravaninthorn and Gaël Raballand, ―Transport Prices and Costs in Africa: a Review of the Main International Corridor (Washington D.C.: World Bank, 2008), 166 pp.

32 The World Bank report referenced in the previous footnote refers to the three poorest and landlocked countries in West Africa, which are Burkina Faso (14th poorest in GDP/capita WB 2015), Mali (21st) and Niger (3rd).

[33] Barak D. Hoffman and George B. O. Kidenda, "Political Economy of Transport Sector Integration in the East African Community" October 2014, 32 pp.

integration and transport economics. From the former, the results resonate with existing studies that argue regional integration efforts are most likely to be successful when one country emerges as a leader in favor of integration and the private sector strongly advocates for it. The authors also support the thesis that transport prices are likely to fall when (1) transport becomes more efficient, (2) road quality improves, and (3) competition becomes more intense. For many years, the second and third condition existed in East Africa, but not the first. Efficiency is now improving along the Northern Corridor but less so along the Central one. The result is that transport prices are falling along the former but not the latter.

The above discussion of transport costs and prices focusses on international transport. While it is relatively easy to calculate the cost and the price of the international transport of goods over long distances, such as on the main corridors to the sea ports, it is much more complicated to determine the price of the transport of goods over shorter distances on the national road network. There is also very little literature on costs and prices of local transport. The price of transport is not only a function of the condition (earth or paved) of the road. It is a function of the distance, because at shorter distances the fixed costs related to the run and to loading and off-loading become increasingly important. The unit price of transport depends also on the quantity: transporting a few bags of rice and their owner to the market will be pricier than transporting a truck full of rice bags. And the larger the truck is, the lower the price will be. And transport by a four-wheel drive truck needed on earth roads, will be pricier. But the price will also depend on whether the return trip is full or empty. Finally, other factors such as speed, frequency, timely availability, and safety all have an impact on the price.

Determining the price of transport of passengers suffers from similar difficulties although to a lesser degree. Improvement of a road from earth to paved condition often induces changes in the vehicles used: from pick-ups and motorcycles before, public passenger transport moves to large buses after the road is paved.

7.2 EVALUATION QUESTIONS

1) **How is the road transport market structured including the government, private sector, and formal and informal sectors?**

This evaluation question will focus on understanding the current road transport market structure, identifying the government's market regulations, and mapping out the relationship between the transport market actors. The Compact's program logic did not fully consider the transport market in its design and recent, relevant information on Burkina Faso's transport market is limited. Therefore, conducting a comprehensive review of the road transport market structure is a critical first step.

2) **Is the current structure optimal for achieving the Compact's goal of poverty reduction through economic growth and increased rural incomes?**

Based on the thorough mapping of the road transport market structure, the team will evaluate how the market influences the Compact's goal. The purpose of this question is to determine elements of the transport market structure that either augment or hinder achieving the Compact's goal. This evaluation question will answer whether the market is regulated in such a way that makes it highly competitive or whether the market is controlled by cartels which prevent any lowering of transport

pricing. In answering the question, the Evaluation Team will focus on providing recommendations where possible to improve the functioning of the transport market in Burkina Faso.

3) Do road transport users benefit from the reduction of VOC and to what extent?

The project logic assumed that any reductions in VOC were project benefits. Yet, the program did not identify to whom these benefits will accrue. For road users that use their own vehicle, it is clear that they benefit from the VOC savings. However, for users relying on transport operators, the savings in VOC can be either transmitted completely to the user in a highly competitive transport market or retained by cartels of transport operators. Since the Compact's overall goal is economic growth, it would be most useful if the reductions in VOC accrued completely to the road users. This would provide a maximum incitement for them to increase production leading to economic growth. This evaluation question will examine to what degree transport costs were reduced for passenger traffic and farmers transporting products after the improvement of the roads.

7.3 EVALUATION APPROACH

7.3.1 Existing Data

Regulatory Environment

The Evaluation Team met with the Secretary General (SG) of the newly formed MTMUSR (March 2016) and with the General Directorate of Land and Maritime Transport (DGTTM). The SG and the Director explained that the administrative and regulatory framework of the road transport sector is governed by Law 025-2008 "*Loi d'orientation des transports terrestres*" (law governing land transport) and Decree 2014-683 governing the profession of road transporter. The Evaluation Team obtained copies of both documents.

According to these documents, every transporter must be licensed. The documents explained that the sector of transport services suffers from a number of issues, among which the most important are: (1) competition of transporters from the neighboring countries; (2) high cost of transport services, compounded by expensive bribes at road barriers; (3) lack of cost control in the road transport; (4) obsolescence of vehicle fleets; (5) low compliance with permissible axle load regulations; and (6) lack of professionalism. The priority for the GoBF is to modernize the sector so that the local transporters can face competition from other countries.

Overloading, though closely related to road maintenance, is also another regional issue that could increase transport costs. The GoBF has recently launched a program allowing the transport companies to import new (or minimally used) trucks without value added tax (VAT), or customs duties. In exchange, the trucking companies agreed with the government to respect axle load regulations. According to a regional agreement, these axle load regulations will be enforced in February 2017 in the coastal countries and in March 2017 in landlocked West African countries. Reducing the load per truck from 45 to 31 tons (Article 14) could increase transport costs.

An area also discussed with the SG and the Director is the regulatory environment for distributing cargo between operators of international transport. The GoBF signed bilateral agreements with all of its corridor partners – Ghana, Cote d'Ivoire, Togo, and Benin – to establish quotas: one third of the freight transport is designated to transit country truckers and two thirds to the Burkinabe truckers. Another rule states that each transporter must take turns (*tour de role*) in transporting the

cargo.[34] These rules stifle competition and prevent the modernization of the profession. The GoBF sought to remove this system for a long time but has not yet succeeded. The main trucking company association, OTRAF, is very powerful and in a monopolistic position.

Price of Transport of Passengers and Goods

The Burkina Shippers Council (*Conseil Bukinabe des Chargeurs*, CBC) is conducting a study on the pricing of transport of passengers and goods.[35] The DGTTM mentioned that following three consecutive reductions of the price of fuel (the price of fuel at the pump is fixed by the government), the government negotiated strenuously with OTRAF and the other organizations to obtain a promise that they would reduce the cost of passenger transport. It is important to note that the sector is theoretically open for competition. The DGTTM also mentioned that the recent arrival of motorized three-wheelers, which are increasingly used in the rural areas for transporting goods and passengers for shorter distances, may put a downward pressure on the prices of transport of cargo and passengers.

The Evaluation Team also met with the President and Secretary General of OTRAF. OTRAF is the largest association of transporters with 5,000 members that own 20,000 vehicles of which 16,000 are more than 3.5 ton. Its members transport passengers as well as goods. According to OTRAF, the market is open for competition but they provide the guidelines for pricing. For example, OTRAF determined that the transport of passengers should cost 15 F CFA/km on paved roads and 18 F CFA/km on earth roads (plus VAT 18 percent and a 50 F CFA tax). But on popular lines such as Ouagadougou-Bobo Dioulasso where there is competition, the real cost is lower; the guidelines indicate 6,422 F CFA, but some companies propose fares as low as 5,000 F CFA. OTRAF mentioned the recent negotiations with the government and confirmed that they agreed to lower fares by 250 F CFA on lines shorter than 100 km and by 500 F CFA on lines longer than 100 km. For the transport of goods, OTRAF guidelines propose fares of 40 F CFA/T.km for export and 26-30 F CFA/T.km for imports. Local transport costs 80 F CFA/T.km up to 110-120 F CFA/T.km for voluminous goods.

The Evaluation Team also met with transport company representatives in Koudougou. The representatives mentioned that paving of the road has been extremely helpful. They are required to do less repairs, traffic has increased, and the rides on the improved roads are more comfortable for the passengers. Prior to the road improvements, only a few pick-ups were arranged for passengers per day and some people were transported by motorcycles. The trips were very uncomfortable because of the dust or mud from the poor road condition. After the road improvements, there are now up to seven buses of 50 to 70 seats each day on the section Koudougou – Didyr (50 km). The price of the trips has come down from 2,500 F CFA to 2,000 F CFA and may be reduced further in the future to 1,500 F CFA. On the section Sabou – Koudougou (24 km), the price has not changed from 1,000 F CFA. However, OTRAF's recommended rate is 475 F CFA for the Koudougou – Didyr route and 1,100 F CFA for the Didyr – Koudougou route. Therefore, it is evident that the prices of the tickets are still well above the recommended

[34] This rule is not official and less respected among the transporters.

[35] The Evaluation Team met with CBC during the first field visit and was promised a copy of the study but did not yet receive it. During the second field visit, it appeared that the study was not yet fully completed. The Evaluation Team contacted the author of the report who confirmed that the study is still ongoing but is expected to be completed in March 2017. For the report, the transport cost is calculated using a model the author developed, which is similar to the HDM-4 VOC model but includes the cost of bribes that were paid according to the Observatory of Abnormal Practices (*Observatoire des Pratiques Anormales*, OPA).

guidelines. It seems that on earth roads with little traffic traveler, the passengers have to pay higher prices. When the roads are improved and more transporters are attracted by the high rates, the transport frequency of passengers will increase.

SOFITEX is a state company that supports cotton growers and manages cotton export. SOFITEX currently covers 80 percent of the market in the west of Burkina Faso, while two smaller companies, SOCOFASO and SOCOMA, cover the center and the east respectively. Transport of cotton is an important operation run by SOFITEX. They own 100 trucks which handle about 50 percent of cotton transport from the growers to the factories while the rest are subcontracted to local truckers. SOFITEX also closely works with the trucking industry for their international transport of cotton. Therefore, SOFITEX often has a dominant position to negotiate low rates with the trucking companies.

Initial Observations

The transport market is organized by the government and each transporter must be licensed, so there seems to be little room for informal transport with the exception maybe of three-wheelers. The Evaluation Team will further investigate this area to confirm the initial findings.

There is no indication of cartels, but the transport associations such as OTRAF lobby the government for support against foreign competitors, and this is effective since they are allowed to import equipment free of VAT and customs duties. The market is theoretically open and competitive but in reality, it is dominated by the supply of transport rather than the demand. Competition apparently has effect on reducing prices for routes with a lot of cargo or passengers but prices remain high for other less popular routes.

The government is focused on addressing issues such as foreign competition, overloading, and professionalization of the sector. For the users, cost may be important but the frequency and comfort of the transport services may also be significant.

7.3.2 Methodology

The Evaluation Team will analyze the transportation market structure and the formal and informal institutions that regulate and govern the transportation market, including possible oligopolistic behavior (e.g., trucking cartels). The Evaluation Team will explore the structure and competitiveness of the transportation sector to understand how likely it is that VOC savings will be passed on to transport consumers, such as public transport users or farmers transporting their produce to markets.

The Evaluation Team will employ qualitative methods to answer the first two questions after collecting reports, documents, statistics, and conducting interviews with the main actors in the government and the private sector. The team will distinguish between international transport, mainly of goods, and local transport. Governments often try to protect their national transporters from foreign transporters. These efforts may have the effect of supporting oligopolistic behavior of the trucking industry as a whole and result in higher transport costs. Local transport may, or may not, suffer from oligopolistic behavior.

The team will also distinguish between the transport of goods and the transport of passengers. The transport of cargo can be separated into two major classes: traders who use their own vehicles to transport goods and small producers who pay for transport. The latter class is at the mercy of the market and oligopolistic behavior while the former class is not. Large producers, or groups of

producers, such as the cotton sector may be in a better position to negotiate substantial benefit from the VOC savings. As for the transport of passengers, those that use their own vehicles will get the transport benefits in full, whereas the passengers of public transport are again reliant on the market and potential oligopolistic behavior.

To answer the third question, the team will mainly employ quantitative methods and draw heavily from Research Area 3, a study on road users. The team will use the results of the HDM-4 VOC model to estimate the real cost saving of transport. The public transport survey, which will be conducted as a part of O-D survey, will be used to estimate the public transport prices before and after the road improvements.

7.3.3 Data Collection

In preparation of the Evaluation Design Report, the team collected a number of documents from various sources and will continue to collect additional documents to address evaluation questions under Research Area 4.

Instrument

Research Area 4 will mainly compose of document review and interviews with key stakeholders in the transport sector. The team will conduct semi-structure interviews, a fairly open framework which allow for focused, conversational, two-way communication. Semi-structured interviews ensure that consistent data is collected yet the individual's perspective about the relative importance of any factor is allowed to come through. The Evaluation Team will ask questions and lead the discussion based on the evaluation questions listed above. Relevant follow-up questions will be asked by the team to obtain more specific information. A stand-alone survey-based data collection is not expected as part of this Research Area.

Sample

The Evaluation Team already held a number of preliminary meetings with the key stakeholders. For data collection, the team will conduct structured KIIs with the main stakeholders in greater detail than the preliminary meetings. The list of stakeholders to be interviewed is as follows. The list below is preliminary and a limited number of additional stakeholders may be added during the data collection phase.

Table 7.1 List of Illustrative Stakeholders for KIIs

Type/Organization	Position Title
Ministry of Transport, Urban Mobility, and Road Security (MTMUSR)	Secretary General
	General Directorate of Land and Sea Transport (DGTTM)
	General Directorate of Sector Work and Statistics (DGESS)
Ministry of Industry, Commerce and Artisans (MICA)	Secretary General
Burkina Shippers Council (CBC)	Director
	Author of the Transport Cost Study
Chamber of Commerce	Representative
Burkina Faso Organization of Transporters (OTRAF)	President
	Secretary General

Type/Organization	Position Title
	Regional representatives in Ouagadougou, Koudougou, Bobo-Dioulasso
Development Partners	World Bank
	African Development Bank
	European Union
	USAID West Africa Trade and Investment Hub representative (representation in Ouagadougou or main office in Accra)
Regional organizations	Francophone West African Economic and Monetary Union (UEMOA)
	Economic Community of West African States (ECOWAS)
Association of Cotton Producers (SOFITEX)	Representative
National Petroleum Company (SONABHY)	Representative
A large cement factory	Representative (for example Diamond Cement in Ouagadougou)
Civil society organizations	To be determined (WA Trade Hub, Borderless Alliance WA)
Media groups	To be determined

The above list of illustrative KII stakeholders partly overlap with the list for Research Area 2. While combining the interviews could save time, the Evaluation Team will conduct the KIIs independently for each Research Area. The team will use different KII questionnaires and may interview different representatives from an organization to elicit response specific to each Research Area.

Rounds and Timing

For Research Area 4, data collection will occur in the fall of 2017. The Evaluation Team will collect and study all relevant documents and meet with the main stakeholders for data collection. The data collection will be completed between three to five months.

Staffing

The Evaluation Team anticipates the data collection and analysis to be completed by the Team Leader and the Political Economist. No additional staffing is anticipated for this Research Area.

Data Processing and Quality

When the team is unable to obtain highly relevant documents in English, the French document (or at least the executive summary) will be translated for the purpose of the evaluation. The team will conduct KIIs in French with the assistance from an interpreter as needed and in English whenever possible. Meeting notes will be drafted in French and/or in English, as necessary.

7.3.4 Analysis Plan

Qualitative data analysis will be used to analyze the data collected from KIIs. The team will classify, sort, and arrange information gathered to identify trends and examine the relationships in

the data. The team will cross-examine information when relevant to help build a body of evidence to support the analysis. The team may use Organizational Network Analysis (ONA) using UCINET software or Stakeholder Analysis[36] to map out the road transport market and identify relationships between the stakeholders involved. For the analysis, linkages between the transport market actors will be evaluated and shown graphically to highlight opportunities and constraints for stakeholders in the environment. KIIs will be used to define relationships between the actors on the basis of information sharing, collaboration, and influence.

Figure 7.1 Example of Organizational Network Analysis (ONA)[37]

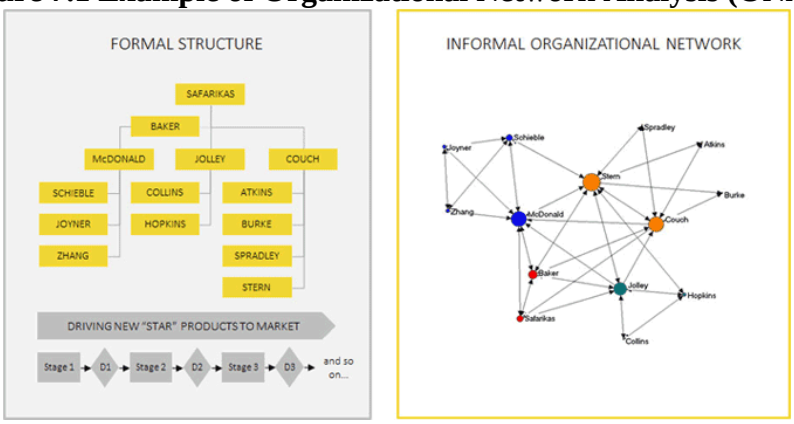
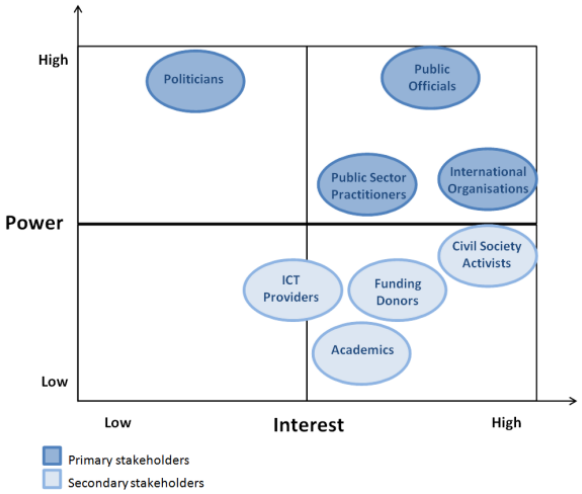


Figure 7.2 Example of Stakeholder Analysis Mapping[38]



Survey of public transport users will provide quantitative data on transport costs borne by passengers. The VOC survey data will be compared to the transport cost to understand whether the benefits of VOC savings were transferred to the road users.

[36] Stakeholder Analysis is a methodology used to facilitate institutional and policy reform processes by accounting for and often incorporating the needs of those who have a 'stake' or an interest in the reforms under consideration. Although originated from the business sciences, it is often used in other settings to understand stakeholders, their positions, and their interest in a particular reform.

[37] Wallace, Greg. "5 Ways Org Network Analysis Can Help You." *Octopus*. N.p., 21 May 2014. Web. 27 Apr. 2017.

[38] Heeks, Richard. "Stakeholder Analysis of Open Government Data Initiatives." *ICTs for Development*. N.p., 17 Dec. 2015. Web. 27 Apr. 2017.

7.4 CHALLENGES

7.4.1 Limitations of Interpretation of the Results or Risks to the Study Design

Limitations of the evaluation design for Research Area 4 is similar to those indicated under Research Area 2.

First, understanding an issue does not imply that MCC (or any other DP) can influence it. External development partners may face severe limits in being able to ameliorate problems in transport market.

Second, stakeholders often have a strong incentive to hide their nefarious activities, such as corruption. Consequently, the Evaluation Team is likely to encounter difficulties in probing and fully understanding some issues, as well as ascertaining the true interests of people engaged in these activities.

VIII. EVALUATION DESIGN – RESEARCH AREA 5: STUDY OF TRAFFIC GROWTH

8.1 EVALUATION QUESTIONS

1) **What are the variations in classified traffic flow on the MCC-funded roads in terms of hourly, day/night, daily, monthly, and seasonal flows?**

The purpose of the question is to identify with some precision the amount of traffic using the MCC-funded roads. Traffic counts have been conducted on MCC-funded primary roads with some degree of regularity. However, the traffic counts are not sufficiently intensive, and in recent years not sufficiently reliable to provide a clear picture of the traffic usage and its variation within and between years. It is important for the evaluation to reveal changes in traffic usage in the years immediately after implementation.

2) **What are the variations in classified traffic flow on the project roads over time?**

Understanding the variations in classified traffic flow over time will form the starting point for longer term monitoring of traffic on the MCC-funded roads. Long-term traffic counting of MCC-funded roads in Burkina Faso will reveal not only the impact of MCC's investment on roads but also indicate the wider effect of improved road infrastructure on national and regional economic development, in terms of traffic growth and vehicle usage.

8.2 EVALUATION APPROACH

8.2.1 Existing Data

Ministry of Infrastructure Traffic Count Program

Since 1993, the MOI has been responsible for conducting regular, semi-annual (April/May and November/December) traffic counts. The counts conducted by the MOI use regular stations and classify traffic by vehicle type (two and three wheelers are excluded). Each count is 7 days in duration. Most traffic counts are 12-hour counts but some are for 24 hours.

The count stations cover all primary roads and many of the rural roads. Since 2000, more than 700 count stations have been included and certain count sites were moved to allow for urban growth and to avoid including significant local traffic. The regional directorates hire individuals, often students, to conduct the traffic counts under their staff supervision. The RDs then process the collected traffic data and send it to the headquarter in Ouagadougou.

For example, Dedougou RD, which was visited by the Evaluation Team, conducts traffic counts at 45 count stations with 17 in the first week of surveys, 18 in the second week, and 10 in the third week. The traffic count covers classified roads, 20 percent of which are paved. The FSRB sends inspectors to check on the traffic count surveys.

The DGESS database contains algorithms to convert the observed data to estimates of AADT. These conversion factors were derived from monthly fuel import data supplied by the National Society of Hydrocarbon under the Ministry of Trade.

In recent years, some delays and interruptions occurred to the MOI traffic count program due to financial restrictions from changes in the road fund (FSRB). The 2014 and 2015 counts are currently being entered into their road database by DGESS of MOI. The database was developed with the assistance of MCA-BF. The MOI did not initiate the 2016 counts until late in the year.

MOI Traffic Count on MCC-funded Roads

MOI provided the Evaluation Team with most of the regular traffic count data for the period of 1993-2012. There are four counting stations on the Dedougou – Mali border primary road which are carried out simultaneously for 24 hours and 7 days. Traffic count survey teams consist of six persons with two always counting with shifts.

Based on the traffic count data provided by the MOI, the Evaluation Team analyzed traffic growth on MCC-funded primary roads between the period of 1993-2011.[39] The AADT from 1993 to 2011 was 6.4 percent for the MCC-funded primary road sections. However, this masks significant variations over the shorter term. Traffic growth from 1993 to 2000 is growth greater than 10 percent per year while between 2000 and 2005 shows a stagnation in traffic growth. From 2005 and 2011, the traffic growth averages 3 percent per year. Light vehicles have grown slightly faster than heavy vehicles. In relation to the national GDP growth[40], the AADT had a factor of 1.10 between 1993 and 2011, which indicates that the traffic on MCC-roads grew 10 percent faster than the GDP during that period. The corresponding values for lights and heavies were 1.13 and 1.06.

MCC Roads Project Traffic Count

MCC implemented an extensive traffic count program for the Roads Project in December 2014 and January 2015, which fills MOI's gap of recent traffic information. There are certain differences in the methodology between the MOI and MCC traffic data but in broad terms the surveys are compatible. Direct comparison is only possible when the full MOI data for 2014 and 2015 is published.

MCC's traffic count program consisted of 65 count stations covering the roads proposed for improvement plus many other parts of the Burkina Faso road network.

[39] Traffic count data from the MOI from 2012 to 2014 require further processing.
[40] World Economic Outlook Database October 2016

The counts were conducted using manual methods and are both extensive and consistent with many counts being conducted simultaneously. The data was collected over a period of approximately seven weeks. The format of the counts is summarized as follows:

- 12-hour duration (0600-1800 hours),[41] classified by hour
- 5-day duration, Monday – Friday
- Overall program period, December 1, 2014 – January 23, 2015 (dry season)
- Vehicle classification: 24 vehicular classes – 5 light/passenger classes, 6 rigid medium/heavy truck classes, 12 articulated heavy vehicle classes plus tractors, 4 two/three-wheel and non-motorized classes
- Link counts only, no junction turning movement counts included.

The survey program effectively comprised a traffic census of Burkina Faso. The following broad observations can be made about this census:

- Traffic volumes are low by international standards with the highest 12-hour flow of approximately 2,000 while most count stations show less than 500 (the average of all station 12-hour flows was 300).
- The counts show the predominance of light vehicles with most of the medium/heavy goods vehicle categories being unrepresented at many count stations.
- The majority of traffic counted throughout the program and at almost every individual count station consists of two-wheelers, motorcycles/mopeds, and bicycles.
- MCC Roads Project's primary roads, as a subset of the whole program, illustrated similar traffic characteristics. There were low volumes of conventional motor vehicles, with 12-hour flows mainly below 250, generally low proportions of medium/heavy vehicles (an exception is the single night-time count), and much more significant numbers of two-wheelers, which on average outnumber conventional motor vehicles by five to one.

The 2014/2015 traffic census carried out for the MCC Burkina Faso Roads Project forms a very useful benchmark for a future long term traffic counting program. Some observations can be drawn from this assessment of the project traffic count program of late 2014/early 2015:

- This was a consistent data collection exercise which can form a useful benchmark for classified traffic volumes on the Burkina Faso road network.
- Traffic counts were conducted at 11 primary road count stations, 6 of which are located at mid-point locations between towns (Roche ST 1, 4, 5, 6, 8, 11) and 5 count stations (Roche ST 2, 3, 7, 9, 10) are located at outskirts of towns (see Annex II for the map of 2014/2015 Roche count stations).
- Traffic counts were conducted at 10 locations on rural roads and at 21 locations on periodic maintenance roads.
- The predominance of two-wheeled vehicles at almost all count stations has implications for relevant engineering and economic studies.
- Further night-time counts would have been useful for such an extensive survey program. While a single night-time count was conducted, this is not sufficient. However, that count indicated the greater heavy goods traffic during the night hours.

[41] Except one night-time count (1800-0600 hours)

- All counts were carried out over the five-day week and some show marked peaks within the week. An extension into the weekend at a limited number of sites would have been useful in establishing the relationship between 5-day and 7-day averages.
- Similarly, the relationship between December/January and the rest of the year, notably the wet season, needs to be confirmed.
- The classification of medium/heavy goods vehicles is overly detailed and does not appear the most practical for Burkina Faso.

8.2.2 Methodology

The study of traffic growth on MCC-funded roads will draw from the considerable experience of MOI in carrying out manual traffic counts at the regional directorate level. Regular traffic counting is well established in Burkina Faso. Available traffic count data over much of the road network goes back as far as 1993. There is a reasonable degree of consistency in the data collection over the period in terms of locations and vehicle classification. However, problems have emerged in recent years due to funding constraints. Traffic counts have continued but increasing delays in implementation and processing/analysis are evident.

MCC's investment in roads also increased the experience and expertise of the MOI in traffic counts. This was evident to the Evaluation Team during the meeting with the Dedougou regional directorate. MOI's experience in conducting traffic counts will be fully utilized and made to form the basis of the traffic counts of the evaluation.

Manual Traffic Counting

The team will conduct manual traffic counting to examine traffic growth on MCC-funded roads over time. The traffic count program will consist of at minimum 7-day/12-hour counts with one day of 24 hours.[42] Counts will include two-wheelers and non-motorized transport because the significance of these classes are illustrated in the 2014/15 MCC-sponsored traffic counts and the Evaluation Team's field trip. The classification of goods vehicles will be kept broadly in line with the MOI program as the MCC census was impractical and inappropriate in its level of detail.

The proposed classification is as follows by direction and hour:

- Car
- 4x4
- Pickup/Van
- Minibus
- Bus/Coach
- 2-axle Medium Goods Vehicle
- 3-axle Heavy Goods Vehicle
- 4+axle Rigid Heavy Goods Vehicle
- Articulated Goods Vehicle
- Agricultural Tractors
- Motorcycles
- Bicycles
- Animal Carts

[42] The Evaluation Team presented two options, either to conduct a 24-hour or 12-hour duration traffic counts, in Chapter 4. Decisions on the approach for Research Area 1 will confirm the traffic count duration.

Automatic Traffic Counting (ATC)

Automatic traffic counters can facilitate continuous counting to collect robust seasonal, monthly, daily, and day/night traffic variation factors. Currently, there is little experience using ATC in Burkina Faso. There are also a number of challenges facing its successful introduction including power supply, heat, dust, and security. However, at both national and regional level, there is an appreciation of the potential of ACTs and an enthusiasm to incorporate their use in longer term traffic monitoring for Burkina Faso.

For now, continuing MOI's regular traffic counting program (with adjustments to reflect the experience of the 2014/15 census) is a priority before exploring the option of establishing an ATC system. Once the manual count program is stabilized, operating three times a year as scheduled, and efficiently producing estimates of AADT, a number of upgrades can be considered, such as:

- Increasing the number of count stations to the maximum as previously administered by the MOI;
- Increasing the frequency of traffic counts from three times per year to either quarterly or monthly; and
- Introducing a controlled automatic traffic counters.

At an early stage of Phase 2, the Evaluation Team will determine whether to develop the longer-term traffic counting program into the practical application of ATCs. The Evaluation Team will determine the introduction of ATCs based on the progress of the regular manual traffic counts.

The main factors in the decision to use ATCs within the current study will include:

- Assessment of their effectiveness in Burkina Faso and identification of the most appropriate ATC format and technology;
- The commitment of stakeholders, notably MoI, towards long-term ATC application;
- The anticipated timeframe for successful establishment of ATC operation, particularly in relation to the timescale of the current project;
- Longer-term unit cost comparison with manual counting, taking into account technological development and its impact on costs and changing labor costs.

The decision will be made in co-operation with MCC and having regard to the views of the relevant stakeholders in Burkina Faso, notably the MOI. If ATCs are to be used, trial installations will be introduced to assess issues of reliability, durability, and security in conjunction with conventional manual counts for calibration.

8.2.3 Data Collection

Instrument

As stated, the surveys in the short to medium term will be predominantly manual. The automation of the traffic counts will be introduced gradually and confirmation on the exact specification of equipment will be determined during Phase 2 of the evaluation. The priority is to ensure that a program of regular traffic counting is confirmed and is sustainable.

Sample

Table 8.1 illustrates the traffic count locations for the primary roads. A total of 16 locations are selected for traffic counts on primary roads. 11 count stations are count stations used by Roche for post-Compact traffic counting in 2014-15. Six of these locations either overlap with or are close

to mid-point locations between towns on the MCC-funded primary roads. Additional 5 mid-point locations between towns are included that do not overlap with Roche stations (see Annex II for maps of the count stations).[43] The Evaluation Team will also conduct traffic counts on rural roads at 10 locations used by Roche post-Compact (also see Annex II for maps of the rural road count stations).

Table 8.1 Primary Road Traffic Count Locations

Traffic Count No.	Road No.		RA 1 Approach	Section Location		Notes
	Official	Study		from	to	
1	RN14	1	Standard	Dedougou	Solenzo junction	km5.9, midpoint (near ST1)
2	RN14	1	Comprehensive	Solenzo junction	Nouna	km 34.2, midpoint
3	RN14	1	Standard	Solenzo junction	Nouna	Roche ST2
4	RN14	1	Standard	Nouna	Bamboroquy	Roche ST3
5	RN14	1	Standard	Nouna	Bamboroquy	km 76.1, midpoint (near ST4)
6	RN14	1	Comprehensive	Bamboroquy	Djibasso	km 108.9, midpoint
7	RN14	1	Standard	Djibasso	Madouba (Mali bp)	km 133, midpoint (near ST5)
8	RR21	2	Standard	Banfora	Toumousseni	Roche ST10
9	RR21	2	Comprehensive	Banfora	Toumousseni	km 5.5, midpoint
10	RR21	2	Comprehensive	Toumousseni	Douna	km 25.1, midpoint
11	RR21	2	Standard	Douna	Sindou	km 44.8, midpoint (near ST11)
12	RN13	3	Standard	Sabou	Koudougou	km 14.6, midpoint (near ST6)
13	RN21	3	Standard	Sabou	Koudougou	Roche ST7
14	RN21	3	Standard	Koudougou	Reo	km 35.7, midpoint (near ST8)
15	RN21	3	Comprehensive	Reo	Didyr	km 62.3, midpoint
16	RN21	3	Standard	Reo	Didyr	Roche ST9

**Note: ST refers to the count stations selected by Roche for post-Compact traffic count*

Rounds and Timing

The Evaluation Team will conduct traffic counts three times (provisionally October 2017, April 2018, and October 2018). The ToR requires a minimum of two traffic counts at each regular count station per year to cover the dry and wet seasons.

Staffing

Traffic count teams will be a minimum of six counters plus one supervisor (supervisor's remit to include more than one count station). The traffic counts will draw as much as possible on the experience of the MOI and its regional and provincial divisions. These organizations have considerable experience of traffic count surveys and will form the first port of call in assisting with recruitment. The precise number of teams in each case will be confirmed when the complete traffic count program is confirmed in consultation with the MCC and stakeholders. The staff will be selected from the most capable and personable traffic counters available and maintain gender-neutrality.

Geographic Data Collection

The Evaluation Team will collect GPS data of each traffic count station using GPS receivers to ensure the count stations are accurately located over time. Under the guidance of a GIS Expert, the

[43] The Evaluation Team initially presented two options for traffic count allocations, either 11 locations or 16 locations, in Chapter 4.

team will graphically present the traffic count information on aerial imagery and itinerary diagrams.

Data Processing and Quality

The survey supervisors will conduct initial checks and will be responsible for identifying any errors or omissions in data collection so they can be corrected on site. Data entry will follow and the Evaluation Team will ensure that the survey supervisors or surveyors are available to discuss and assist with any problems arising during data entry. To the extent possible, selected surveyors will continue their employment as data entry staff. This will provide consistency between site and data entry procedure. The resulting input files will be subject to a thorough data quality check prior to analysis and, where necessary, returned for re-entry or correction.

The subsequent analysis will also provide further checks, both through the software used to hold the data, for example Excel, and in the results obtained following the first run of the analysis. Experienced assessment will identify where initial results are questionable and working backwards will confirm whether data entry or data collection was faulty.

HDM-4 will also form a final checking barrier of traffic count data. Where results are highly inconsistent or unexpected references to the original data may be required and, if necessary, the specific items of data edited or deleted.

8.2.4 Analysis Plan

The data collected from the traffic counts will be entered into Excel for data processing and analysis. The Transport Economist/Modeling Expert will lead the analysis process of the repeated traffic counts.

Traffic growth consists primarily of *normal* traffic growth, driven by national and regional economic development with an element of *generated* traffic, new trips produced as a result of road investment. *Diverted* traffic is traffic shifting to MCC roads from other roads and routes as a result of the road investment. The Evaluation Team will use the O-D survey and the public transport surveys to identify the separate types of traffic growth subsequent to MCC's road investment.

The findings of the individual data collection efforts will be recorded in itinerary diagrams as well as on high-resolution aerial photography. All pre- and post-Compact road conditions available will be documented and shown on the itinerary diagrams. A sample itinerary diagram shall be developed for MCC review and approval during the inception period and before beginning the work on all of the itinerary diagrams. The team will hire a GIS Expert to assist this process.

8.3 CHALLENGES

8.3.1 Limitations of Interpretation of the Results or Risks to the Study Design

The single most significant risk to data collection is its reliability in determining robust estimates of AADT. The timing of the traffic counts and their subsequent adjustment will determine the estimates of AADT obtained. The risk of inaccuracy is primarily reduced by extending the survey period (effectively increasing the sample).

Therefore, the precise timing of the initial traffic counts will be carefully considered to continue the counts for as long as practical in the context of this study. The adjustment factors used to derive estimates of AADT will also be carefully reviewed.

A more intensive program of traffic counting with selected locations being surveyed quarterly or monthly could also mitigate the risk of data inaccuracy. Automatic traffic counters can potentially provide continuous count data and nullify the risks associated with the use of short-term counts.

However, automatic traffic counters come with their own limitations and risks in terms of application. In addition to the lack of experience of ATCs in Burkina Faso, there are potential risks related to security, heat, and dust. Therefore, all installations will need to be thoroughly tested and calibrated before their output can be used confidently. The precise form of calibration will vary depending upon the ATC methodology adopted but will almost certainly include a manual calibration count to assess accuracy of both count and classification. Ease and continuity of accurate operation will be key to the selection of the appropriate ATC technology for the Burkina Faso Roads Project.

IX. ADMINISTRATIVE

9.1 SUMMARY OF IRB REQUIREMENTS AND CLEARANCES

The Evaluation Team will prepare and submit an Institutional Review Board (IRB) application to an IRB registered with the Office for Human Research Protections with the US Department of Health and Human Services for approval of the research and data collection plan. The Team anticipates only minimal psychosocial stress and related risks for the research participants.

The application materials for IRB will include four sets of documents: 1) a copy of the Design Report, 2) a copy of the O-D survey protocol, 3) copies of all data collection instruments that will be used for the survey, and 4) a completed IRB application form summarizing protection of participant's rights and data safety. All materials will be translated into French by the Evaluation Team before submission and the interviews of road users will be conducted in French.

The selection of the participants to the O-D survey will respect the principle of equity since participants will be randomly selected among the road users on MCC-funded road segments. The O-D survey procedures will be based on the principles of voluntary participation and informed consent. Prior to participating in the survey, the road users interviewed will be given sufficient information on the objective of the survey and the use of the data collected to decide whether they wish to participate in the survey. The informed consent statement will closely follow the guidelines provided by MCC.

9.2 APPROVAL FROM LOCAL AUTHORITIES

For the collection of field data, the Evaluation Team will contact the necessary authorities early and work closely to ensure their timely cooperation. The team will acquire official approval for data collection from the bus station authorities, the police, weight station authorities, toll stations, and the MTMUSR.

9.3 DATA PROTECTION, ACCESS, AND DOCUMENTATION

The study will ensure that the confidentiality of information obtained from or about human participants is maintained. The Evaluation Team will ensure that the raw datasets are cleaned and

de-identified closely following MCC's guidelines for public use of data. The obtained data will be stored in a secured server with limited access to key project personnel who signed the non-disclosure agreement.

The Evaluation Team will provide both raw, non-de-identify dataset and clean, de-identified dataset to MCC for public and internal use. The public-use dataset will be free of personal or geographic identifiers that would permit identification of individual respondents. Any additional variables with risk of divulging identity of individual subjects will be removed. In order to facilitate access to and usability of data, all datasets delivered to MCC will be accompanied with completed documenting in the form of standardized metadata.

9.4 DISSEMINATION PLAN

The Roads Analysis Report and the Maintenance Policy Assessment Report will be submitted to MCC in March 2019. The Evaluation Team will also submit the final datasets (a raw dataset and an de-identified dataset) and the analysis files. Feedback from MCC and local stakeholders will be incorporated to produce the final reports in June 2019. Upon review by the Evaluation Management Committee, the Evaluation Team will present the results of the evaluation in Ouagadougou and Washington DC. The Evaluation Team will deliver to MCC the entire contents of the project library in good order and properly indexed and marked in both digital and paper copy.

9.5 EVALUATION TEAM ROLES AND RESPONSIBILITIES

The Evaluation Team has five key personnel that work closely together for evaluation. The table below presents each of the key personnel on the Evaluation Team and their responsibilities. The support team will provide technical and administrative capacity to carry out the project activities and achieve MCC's goal and objectives. The diagram (Figure 9.1) below shows the organizational chart of the complete Evaluation Team.

Table 9.1 Evaluation Team and Responsibilities

Name	Position	Responsibility
Eddy Bynens	Team Leader/ Road Maintenance Expert	• Evaluation Coordination and Quality Control • Technical Lead for Evaluation of Research Area 4: Study on transportation market structure • Technical Support for Evaluation of Research Area 2: Political economic analysis of road maintenance
Steve Crudge	Transport Economist/ Modeling Expert	• Technical Lead for Evaluation of Research Area 1: Cost-benefit analysis of MCC-funded roads • Technical Lead for Evaluation of Research Area 3: Study on road users using Origin-Destination survey • Technical Lead for Evaluation of Research Area 5: Study on change in traffic growth
Barak Hoffman	Political Economist	• Technical Lead Evaluation of Research Area 2: Political economic analysis of road maintenance

Name	Position	Responsibility
		• Technical Support for Evaluation of Research Area 4: Study on transportation market structure
Gift Khozapi	Cost Benefit Analyses Expert	• Technical Support for Evaluation of Research Area 1: Cost-benefit analysis of MCC-funded roads
Hippolyte Lingani	Transport Expert	• Technical Support for all evaluation research areas • Liaison with Agence du Partenariat pour le Développement (APD-Burkina)
TBD	GIS Expert	• Technical assistance overlaying data collected on satellite imagery and aerial photos • Administrative support obtaining and managing satellite imagery and aerial photos of MCC-funded roads
TBD	Senior Pavement Engineer	• Technical support for data collection of Research Area 1: Cost-benefit analysis of MCC-funded roads, especially for road roughness survey, surface distress survey, deflection measurement survey, and pavement structure survey

9.6 EVALUATION TIMELINE & REPORTING SCHEDULE

The work plan for the evaluation is outlined below (Figure 9.2). The plan accounts for each of the major deliverables along with the expected timeline of the evaluation.

Figure 9.1 Evaluation Team Organization Chart

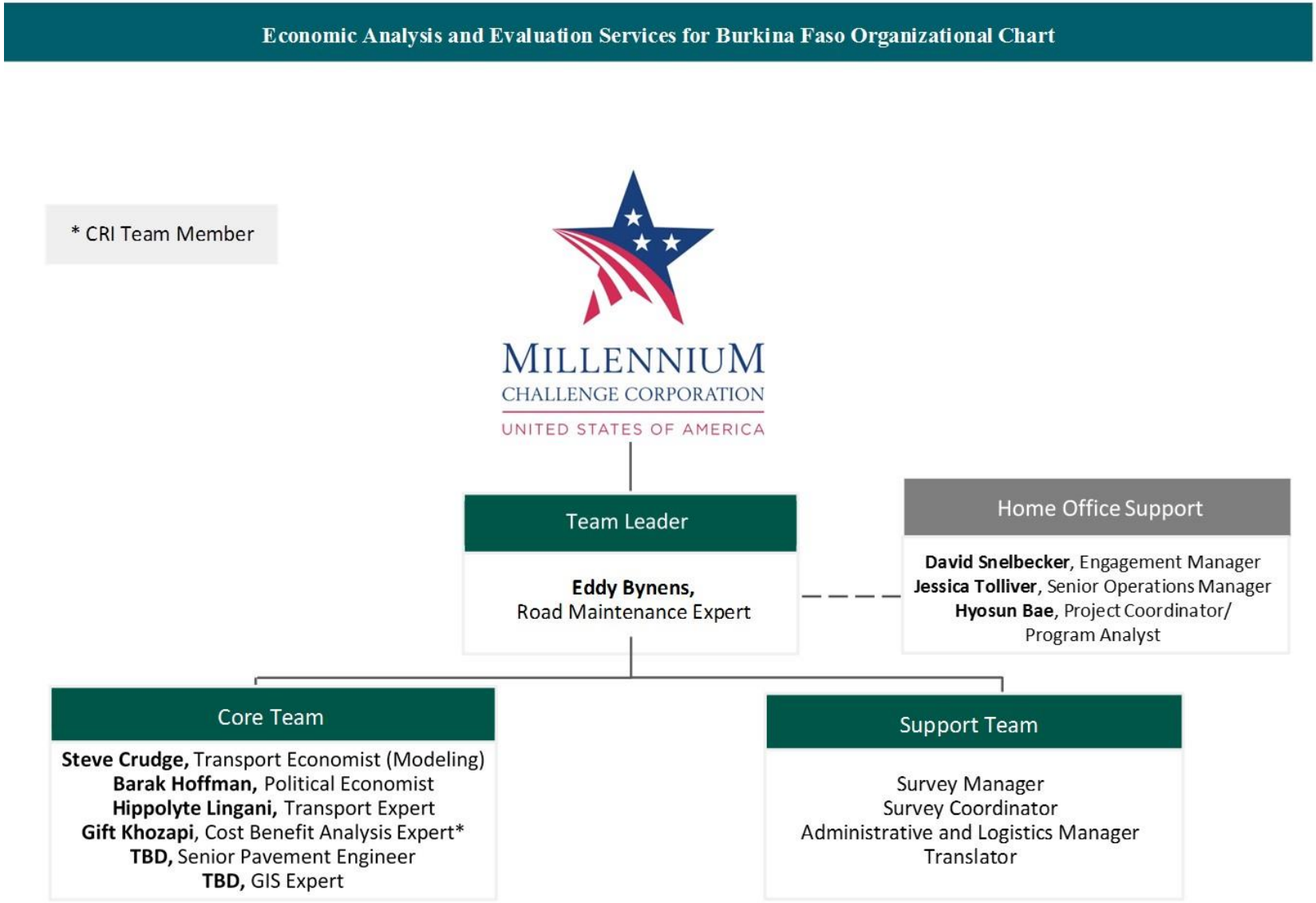


Figure 9.2 Evaluation Workplan for Phase 2 and Phase 3

Work Plan																																					
		2017								2018												2019												2020			
Activity	**Responsibility***	May	Juen	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Reporting																																					
Submit Monthly Progress Report	Home Office			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Phase II - Option Period I																																					
Task 3: Develop Evaluation Materials																																					
Submit SOW, Trip Report for each country visit	Team Leader, Core Team				■	■																															
Revise the Evaluation Design Report as evaluation develops	Team Leader, Core Team			■	■	■	■																														
Draft and submit data collection firm terms of reference	Team Leader, Survey Manager, Survey Coordinator, Senior Pavement Engineer			■																																	
Identify local firms and solicit response from data collection firms and select a firm	Team Leader, Survey Manager, Survey Coordinator, Program Analyst, Senior Pavement Engineer			■																																	
Draft survey questionnaires, data collection instruments, and training manuals	Team Leader, Core Team			■	■																																
Submit translated French version of data collection instruments	Team Leader, Translator				■																																
Incorporate feedback from MCC and local stakeholders on evaluation materials	Team Leader, Core Team				■																																
Submit written review of back-translation	Team Leader, Core Team					■																															
Submit final versions of French and English data collection instruments	Team Leader, Core Team					■																															
Travel to conduct field work (Trip 3)	Team Leader, Transport Economist /Modeling Expert, Senior Pavement Engineer					■																															
Train data collection firm enumerators	Transport Economist /Modeling Expert, Survey Manager, Survey Coordinator, Senior Pavement Engineer					■																															
Conduct pilot tests for all data collection methods	Transport Economist /Modeling Expert, Survey Manager, Survey Coordinator, Senior Pavement Engineer					■																															
Submit summary of pilot tests for all data collection methods	Team Leader						■																														
Submit work plan for data collection	Team Leader						■																														
Submit IRB package including research protocol, informed consent statements, and other documents and approvals	Team Leader						■																														

Work Plan																																					
		2017								2018												2019												2020			
Activity	Responsibility*	May	Juen	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Task 4: Prepare and Implement Data Collection																																					
Submit SOW, Trip Report for each country visit	Team Leader					■																															
Revise/update evaluation materials as required during data collection	Team Leader, Core Team						■																														
Travel to conduct field work (Trip 4 & 5)	Team Leader, Transport Economist/Modeling Expert, Political Economist, Senior Pavement Engineer							■																													
Conduct road roughness survey, surface distress survey, deflection measurement survey, pavement structure survey, and VOC survey	Team Leader, Transport Economist/Modeling Expert, Senior Pavement Engineer						■	■					■	■																							
Collect data on traffic count, ensure quality assurance and quality control	Transport Economist /Modeling Expert, Survey Manager, Survey Coordinator						■	■					■	■				■																			
Monitor data and process data entry	Survey Manager, Survey Coordinator						■	■					■	■				■																			
Submit written minutes of meetings with data collection firms	Team Leader, Survey Manager, Survey Coordinator						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■																
Submit Data Collection Report summarizing results, data collection implementation efforts, challenges encounters, and data quality control checks conducted	Team Leader, Core Team, Program Analyst							■					■	■																							
Obtain aerial imagery of each road evaluated	Team Leader, Transport Economist/Modeling Expert, GIS Expert								■																												
Submit aerial imagery of each road overlaid with the IRI, traffic, O-D, Adjusted Structural Number, and any road condition evolution data	Team Leader, GIS Expert															■	■																				
Submit revised Phase III budget for MCC approval/technical directive	Team Leader, Home Office Support																		■																		
Deliverable approval/Contract modification	MCC																		■	■																	

Work Plan																																								
		2017								2018												2019												2020					
Activity	Responsibility*	May	Juen	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Phase III - Option Period II																																								
Task 5: Develop Roads Analysis Report and Data Files																																								
Submit SOW, Trip Report for each country visit	Team Leader																																							
Clean data, produce a cleaned dataset, and analyze data using statistical software, modeling programs	Team Leader, Core Team, Program Analyst																																							
Submit Data Collection Inventory with summary data and analysis	Team Leader, Survey Manager, Survey Coordinator																																							
Obtain satellite imagery pre-construction project	Team Leader, Home Office Support, GIS Expert																																							
Submit documentation of local stakeholder and MCC feedback an response	Team Leader																																							
Draft and submit Roads Analysis Report including HDM-4 Analysis, the Assessment of Maintenance Policy, and recommendations covering Research Areas 1-5	Team Leader, Core Team																																							
Submit final raw, anonymized data and analysis files (STATA do files)	Team Leader, Program Analyst																																							
Conduct a workshop and incorporate feedback on Final Roads Analysis Report from MCC and local stakeholders	Team Leader, Transport Economist/Modeling Expert																																							
Present the Roads Analysis Report findings to the Evaluation Management Committee	Team Leader																																							
Task 6: Disseminate Results																																								
Submit SOW, Trip Report for each country visit	Team Leader																																							
Present results of the Roads Analysis Report findings at MCC headquarters and MCA/Burkina Faso and submit final PowerPoint presentation	Team Leader																																							
Deliver entire contents of the project library in digital and paper copy for public distribution	Team Leader, Home Office Support																																							

ANNEX I: ILLUSTRATIVE SURVEY INSTRUMENT FOR ORIGIN-DESTINATION SURVEY

A. Proposed Roadside Interview Form

N°	Hour	Vehicle Type	Ownership	Vehicle Nationality	Origin	Destination	Number of Passengers	Journey Purpose	Goods Carried	Goods Tonnage	Frequency of Journey
1											
2											
3											
4											
5											

Note: Each line represents a single interview with a road user

This has been taken straight from the Compact O-D surveys. The only proposed change would be to add gender as a category and to include the below list of journey purposes:

- Work/Business in work time
- Personal business
- Market/Shops
- Education
- Social/Leisure
- Tourism
- Other

B. Proposed Public Transport User Interview Form

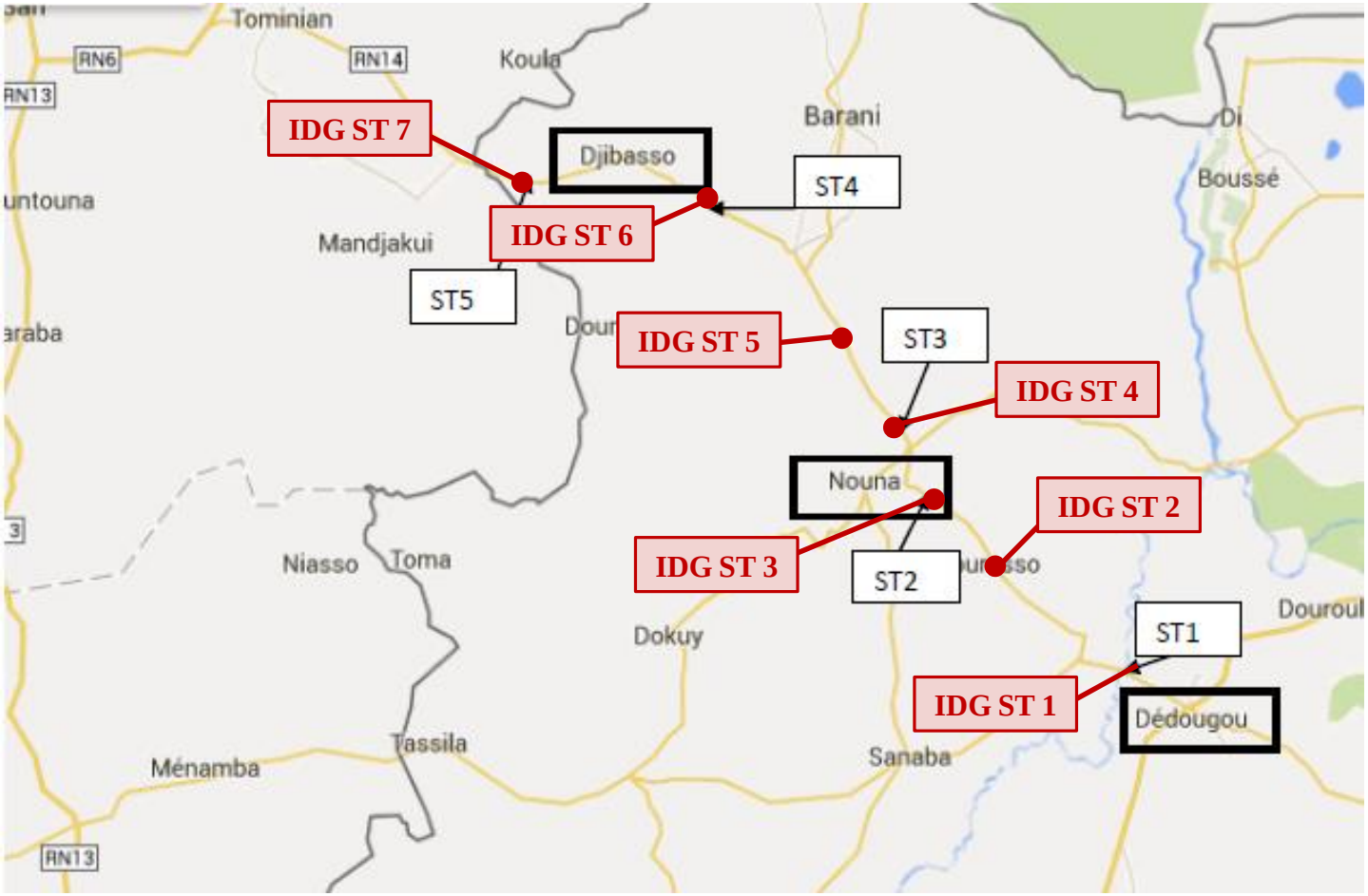
N°	Hour	Origin	Destination	Journey Purpose	Current Cost of Journey	How long have you been making this journey?	How has the Journey Changed?		Frequency of Journey
							Cost	Quality (Better/Same/Worse)	
1									
2									
3									
4									
5									

Note: Each line represents a single interview with a public transport user

The "How has the Journey Changed?" question would be asked of those interviewees who respond that they had been making the particular journey over a period of more than one year.

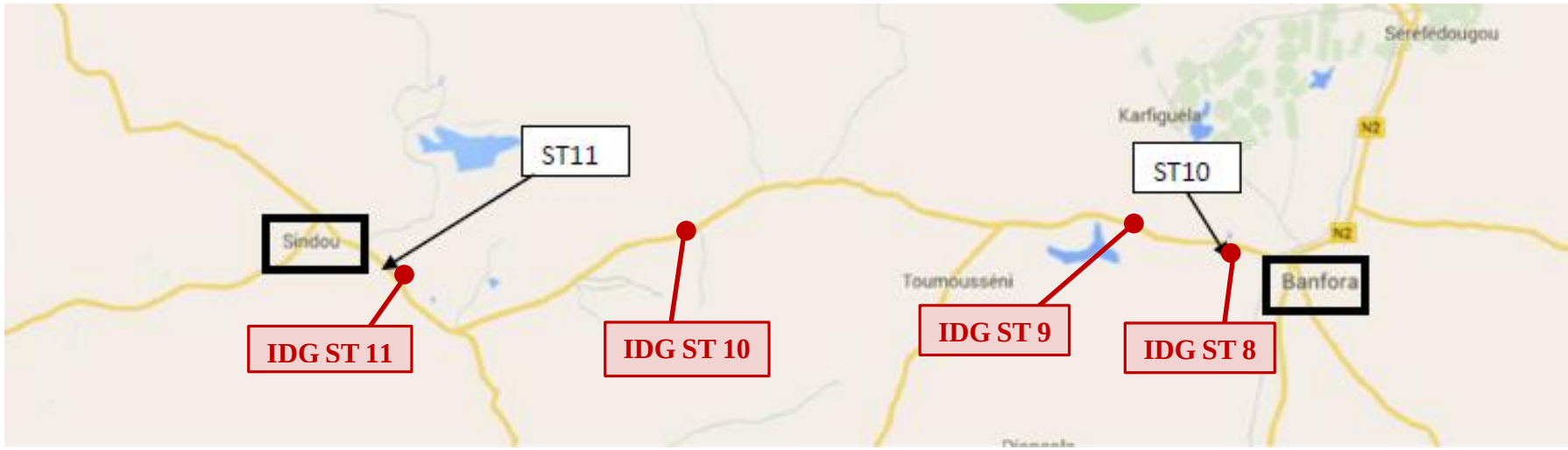
ANNEX II: MAP OF TRAFFIC COUNT LOCATIONS

Map of Primary Road 1 Traffic Count Stations (RN 14)

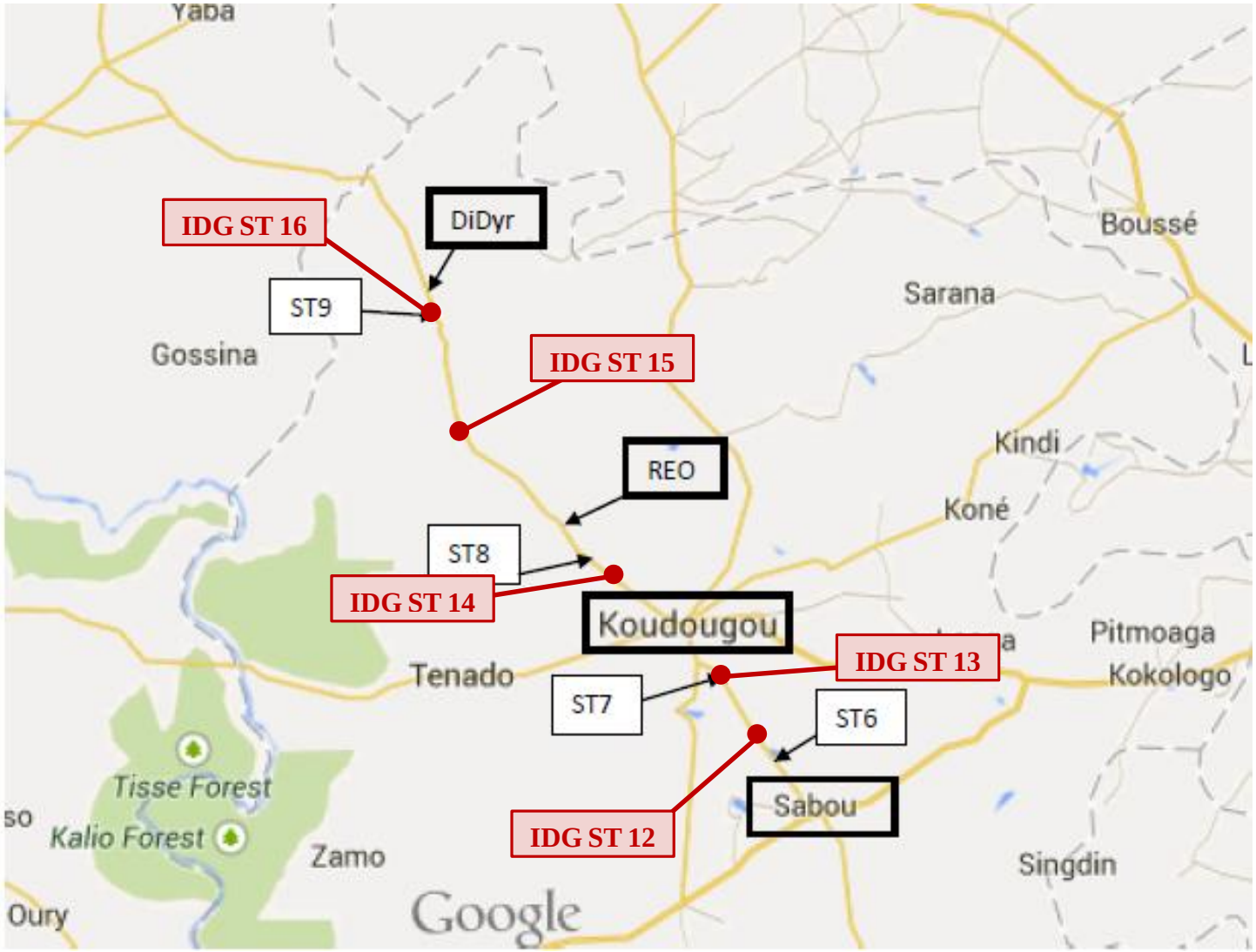


* Source: Rapport de Missions de Roche (Decembre 2014 – Janvier 2015)
** Note : ST indicates traffic count locations used by Roche, IDG ST indicates traffic count locations selected by IDG.

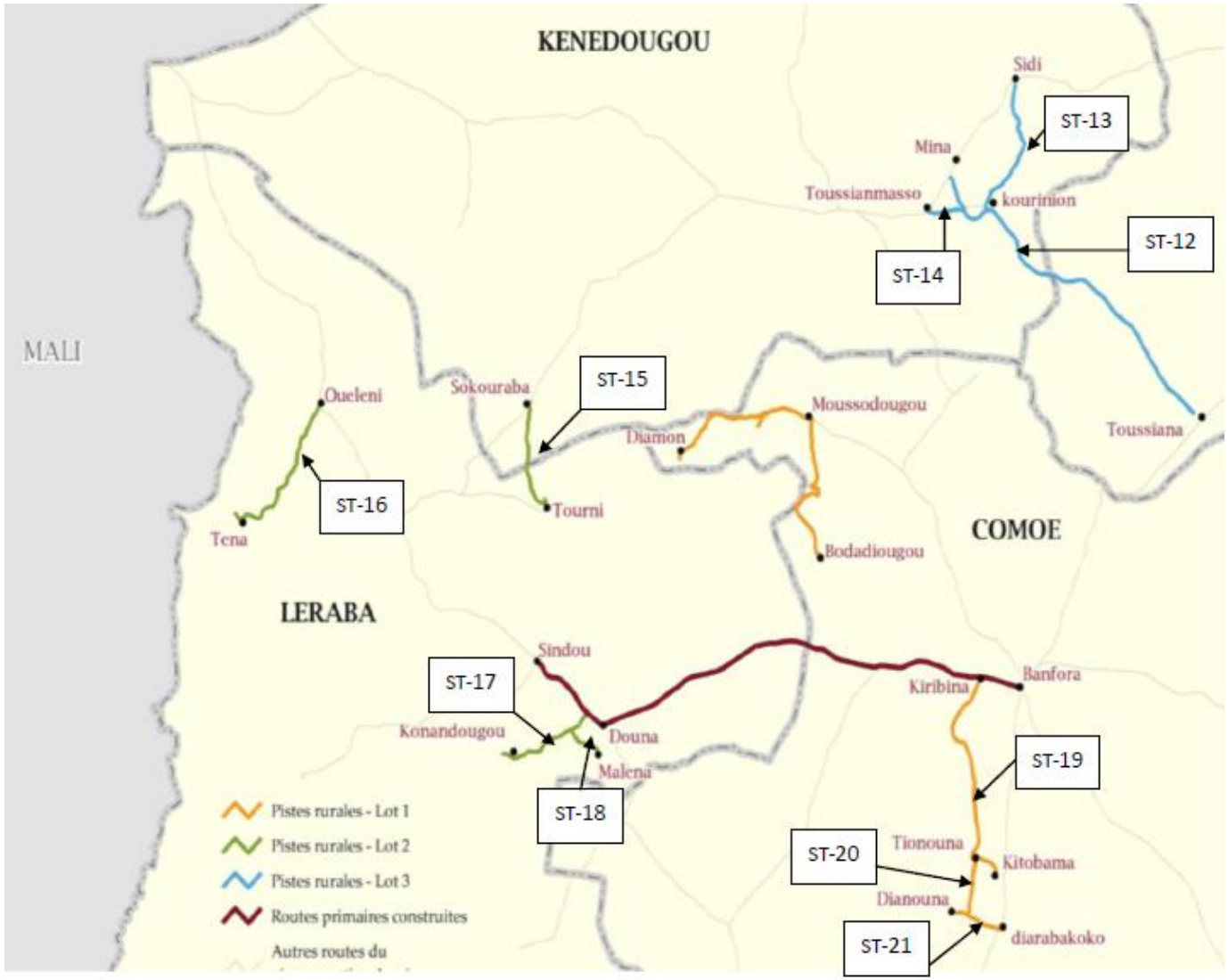
Map of Primary Road 2 Traffic Count Stations (RR 21)



Map of Primary Road 3 Traffic Count Stations (RN 21)



Map of Rural Road Traffic Count Stations



** Note: counting station locations used by Roche will be used for the evaluation*

ANNEX III: HDM-4 REPORT

Level 1 Highway Development and Management-4 (HDM-4) Calibration Report

TABLE OF CONTENTS

LIST OF ACRONYMS

AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
AfDB	African Development Bank
AGETIB	Burkina Faso Infrastructure Works Agency
APD	Development Partnership Agency (Agence du Partenariat pour le Développement)
ATC	Automatic Traffic Count(er)
BB	Benkelman Beam
BI	Bump Integrators
BRIGHT	Burkinabe Response to Improve Girls' Chances to Succeed
CBA	Cost-Benefit Analysis
CBC	Burkina Shippers Council (Conseil Burkinabe des Chargeurs)
CFA	Central African Franc
DG	General Directorates
DGER	General Directorate of Roads Maintenance (Direction Générale de l'entretien routier)
DGESS	General Directorate of Sector Work and Statistics
DGNETC	General Directorate of Standardization, Engineering Studies and Control
DGPR	General Directorate of Rural Roads (Direction Générale des Pistes Rurales)
DGR	General Directorate of Roads (Direction Générale des Routes)
DGTTM	Director of Land and Sea Transport
DP	Development Partner
EAC	East Africa Community
ECOWAS	Economic Community of West African States
ERR/EIRR	Economic (Internal) Rate of Return
FER-B	Road Maintenance Fund of Burkina (Fonds d'Entretien Routier du Burkina)
FSRB	Burkina Faso Special Road Fund (Fonds Spécial Routier du Burkina Faso)
GiZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoBF	Government of Burkina Faso
HDM-4	Highway Development and Management
HGVS	Heavy Goods Vehicles
IDG	International Development Group LLC
IMFPM	Incentive Matching Fund for Periodic Maintenance

IRI	International Roughness Index
ITT	Indicator Tracking Table
KII	Key Informant Interview
LNBTP	National Public Buildings and Works Laboratory
M&E	Monitoring and Evaluation
MCA-BF	Millennium Challenge Account Burkina Faso
MCC	Millennium Challenge Corporation
MEFD	Ministry of Economy, Finance, and Development (Ministère de l'Economie, des Finances et du Développement)
MOI	Ministry of Infrastructure (Ministère de l'infrastructure)
MT	Motorized Transport
MTMUSR	Ministry of Transport, Urban Mobility, and Road Security (Ministère des Transports, de la Mobilité Urbaine et de la Sécurité Routière)
OTRAF	Burkina Faso Organization of Transporters
NGO	Non-Governmental Organization (Organiaion des Transporteurs du Faso)
NPV	Net Present Value
O-D	Origin-Destination
PCSE	Passenger Car Space Equivalent
PRP	Poverty Reduction Paper
RD	Regional Directorates
RED	Road Economic Decision
SG	Secretary General
SOFITEX	Association of Cotton Producers (Société Burkinabé des Fibres)
ToR	Terms of Reference
UEMOA	Francophone West African Economic and Monetary Union (Union Economique et Monétaire Quest-Africaine)
VAT	Value-Added Tax
VOC	Vehicle Operating Cost(s)

I. INTRODUCTION

1.1 BURKINA FASO ROADS PROJECT OVERVIEW

After a two-year preparatory period, the Millennium Challenge Corporation (MCC) signed a Compact with the Government of Burkina Faso (GoBF) on July 14, 2008. The Compact came into force in July 2009 and was in effect for five years until July 2014. The goal of the Compact was to reduce poverty in Burkina Faso through economic growth. The Compact consisted of four main projects: 1) Rural Land Governance Project, 2) Agriculture Development Project, 3) Roads Project, and 4) Burkinabé Response to Improve Girls' Chances to Succeed (BRIGHT) II School Project.

MCC's Burkina Faso Roads Project consisted of the following principal activities:

1) Development of Primary Roads: To improve three primary road sections totaling 271 km in length in western Burkina Faso.
2) Development of Rural Roads: To improve 151 km of rural road segments from rural tracks to a fully engineered rural roads standard in southwestern Burkina Faso.
3) Capacity Building and Technical Assistance for Road Maintenance: To provide capacity building and technical assistance to existing government agencies and private sector institutions involved in road maintenance activities.
4) Incentive Matching Fund for Periodic Maintenance (IMFPM): To fund periodic maintenance on the condition that the Government fulfilled a certain number of conditions related to maintenance activities including a Government increase in funding for periodic maintenance.

Under Activity 1, the three primary roads rehabilitated with MCC funding were:

- Dedougou – Nouna – Mali border (145 km)
- Banfora – Sindou (50 km)
- Sabou – Koudougou – Didyr (76 km)

1.2 INTRODUCTION TO HDM-4

The Highway Development and Management-4 (HDM-4), originally developed by the World Bank, is now one of the world's premier model for economic evaluation of road maintenance, rehabilitation, and improvement. The HDM-4 is a decision-making tool to predict economic return of highway investments. It also acts as a planning and programming tool for medium to long term maintenance expenditure of road networks. The HDM-4 is intended for application across the world in different technological and climatic conditions.

In essence, the HDM-4 model compares the costs (capital and recurrent) of a road investment with the resultant benefits to road users. These benefits primarily comprise of reduction in vehicle operating cost (VOC) and savings on travel time. Reductions in accident costs and decreased future maintenance expenditure are also additional benefits from road investments. Time savings and reduced VOC and accident costs result from a combination of improvements in road standard/design, surface condition (notably roughness), and structural strength.

The two critical relationships within the HDM-4 model are:

- Road deterioration as a factor of road construction and maintenance, traffic loadings and climatic conditions.
- Vehicle operating costs as a factor of background economic conditions, road deterioration and subsequent maintenance and rehabilitation/construction.

Application of the HDM-4 model involves two important steps:

- Data input: Correct interpretation of the data input requirements, and obtaining quality input data appropriate to the desired reliability of the results.
- Calibration of outputs: Adjusting the model parameters to enhance the accuracy of its representation of local conditions.

The international character of HDM-4 enables it to be widely used but its application to specific countries and regions requires considerable care. Calibration to local conditions, particularly in terms of the two key relationships identified above, is essential. Calibration of HDM-4 aims to improve the accuracy of both predicted pavement performance and vehicle resource consumption and, consequently, strengthen the results of the evaluation. The three levels of HDM-4 calibration requires low, moderate, and high level of effort and resources respectively depending on its level of rigor:

1) Level 1 - Application

   Determines the values of required input parameters based on a desk study of available data and engineering experience of pavement performance, adopts many default values and calibrates the most sensitive parameters with best estimates.

2) Level 2 - Verification

   Requires measurement of additional inputs and moderate field surveys to calibrate key predictive relationships to local conditions.

3) Level 3 - Adaptation

   Experimental data collection required to monitor the long-term performance of pavements within the study area, which should be used to enhance the existing predictive relationship or to develop new and locally specific relationships for substitution in the model.

1.3 OBJECTIVE

In September 2016, International Development Group LLC (IDG) was contracted by MCC to conduct an economic analysis and a performance evaluation of the MCC Burkina Faso Compact's Roads Project. The objective of the Level 1 HDM-4 Calibration Report is to present the economic benefits of the project's rehabilitated primary roads based on level 1 HDM-4 modeling using secondary sources and best estimates of data parameters.

This report is a reliable starting point for evaluating the economic viability of MCC-funded Roads Project. The Evaluation Team will update the level 1 HDM-4 parameters from this report based on data collection to estimate the final HDM-4 results.

It is important to note that the level 1 calibration of HDM-4 is limited to the MCC-funded primary roads. The rural road segments (Activity 2) are not included in the HDM-4 analysis because the functions of these roads are not based on highway economics.

In this report, the team will: i) provide details on the configuration of HDM-4, 2) discuss the data and sources for level 1 HDM-4 calibration, and iii) present the analysis parameters.

1.4 STAKEHOLDER CONSULTATION

The Evaluation Team consulted extensively with the local stakeholders for level 1 HDM-4 calibration, including the following organizations:

- The Ministry of Infrastructure (MOI) acted as the coordinator on behalf of the consultant for the existing data within their responsibility.
- The DGESS (*Direction Generale de l'Economie et des Statistiques*) was consulted about previous HDM-4 runs for the preparation of the 5-year periodic maintenance plans.
- The DGNETC (*Direction Generale de la Normalisation des Etudes Tech et du Contrôle*) was consulted about previous HDM-4 runs for the preparation of the 5-year periodic maintenance plans and provided the latest and recent HDM-4 workspaces used under the MOI.
- The LNBTP (*Laboratoire National du Bâtiment et des Travaux Public*s) was consulted about pavement materials and deflection data.
- The FSRB (*Fonds Spécial Routier du Burkina Faso*) detailed the 5-year periodic maintenance plans which are modelled in the HDM-4 workspaces held by MoI DGNETC.
- Regional and Provincial Directorates responsible for the Project Roads were consulted about road usage, condition and maintenance.
- UEMOA (*Union Economique et Monétaire Quest-Africaine*) provided information regarding axle-loading in Burkina Faso.
- International Funding Institutions, African Development Bank, European Union and World Bank were consulted regarding recent highway studies undertaken in Burkina Faso using HDM-4.

II. CONFIGURATION OF HDM-4

2.1 OVERVIEW

The adaptation of HDM-4 for analyzing roads in Burkina Faso involves two major activities: configuration and calibration. Prior to using HDM-4 for the first time in any country, the system should be configured and calibrated for local use.

The primary objective of configuration is to make the analysis of the model relevant and compatible to the environment and conditions prevailing in Burkina Faso. This requires revising the default configuration data in line with conditions and practices in Burkina Faso.

HDM-4 configuration includes the following activities:

1) Provision of information on the climatic conditions prevailing in Burkina Faso, different road types and functional classes, and the pavement types that constitute the road network.
2) Definition of the general characteristics of traffic flow on the different road types in the network; traffic composition by representative vehicle types and traffic growth rates pertaining to each class.
3) Definition of road surface condition in aggregate form (e.g. good, fair, poor) based on measures of surface distresses (e.g. cracking, raveling, rutting, potholes, edge break, roughness, thickness of gravel) to conform to local standards and practices.
4) Estimation of pavement strength of the various road types expressed in terms of structural number.

The initial, pre-investment analysis of the primary roads used the spreadsheet-based software RED (Road Economic Decision tool) which is effectively a simplified version of HDM-4 with the detailed road deterioration component is replaced by a simple before and after value of road surface quality.

The DGNETC of the MOI conducted the latest systematic configuration of HDM-4 in 2014. The configuration was carried out as part of the HDM-4 Level 2 Calibration Study, which was conducted on behalf of MOI with the support from German Corporation for International Cooperation (GiZ) and MCC.[44]

The HDM-4 configuration work carried out by the Level 2 Calibration Study which was completed in early 2014 is summarized in the following section.

2.2 HDM-4 CONFIGURATION

Representative Vehicles

Vehicles on MCC-funded roads were categorized into different vehicle classes. Vehicle models with characteristics representative of a certain class were selected as representative vehicles. The selected vehicle models represented the vehicle fleets appropriate for Burkina Faso's entire national road network.

Climate Zones

Climate data from the meteorological department in Burkina Faso was used to divide Burkina Faso into Climate Zones. For each climate zone the following HDM-4 parameters were defined:

- Moisture Index
- Duration of dry season as a percentage of the year
- Mean temperature
- Number of days with temperature greater than 35 degrees Celsius
- Freeze index
- Percentage of time vehicles are driven on wet roads

[44] While the final report was issued in early 2014, its recommendations and the resulting HDM-4 database have not yet received final official approval.

Road Network Aggregate Data

Configuration of aggregate data involved the definition of aggregate information for the following:

- Traffic levels: e.g., low, medium, high
- Geometry class: in terms of parameters reflecting horizontal and vertical alignment
- Pavement characteristics: structure and strength parameters defined by pavement surface class
- Road condition: ride quality, surface distress and surface texture
- Pavement history: construction quality, pavement age, etc.

Traffic Flow Pattern

Levels of traffic congestion vary with the hour of the day and on different days of the week and year. In order to determine traffic flow pattern encountered within the Burkina Faso road network, the number of hours of the year (out of a total of 8,760) were assigned to different ranges of hourly flows.

Speed Flow

Data collected from speed-flow surveys was used to configure the HDM-4 speed flow model for different road types. The speed-flow model adopted in HDM-4 for each motorized transport (MT) is the three-zone model illustrated in Figure 2.1.

- Qo: the flow level below which traffic interactions are negligible in Passenger Car Space Equivalent (PCSE) per hour
- Qnom: nominal capacity of the road (PCSE/h)
- Qult: the ultimate capacity of the road for stable flow (PCSE/h)
- Sult: speed at the ultimate capacity, also referred to as jam speed (km/h)

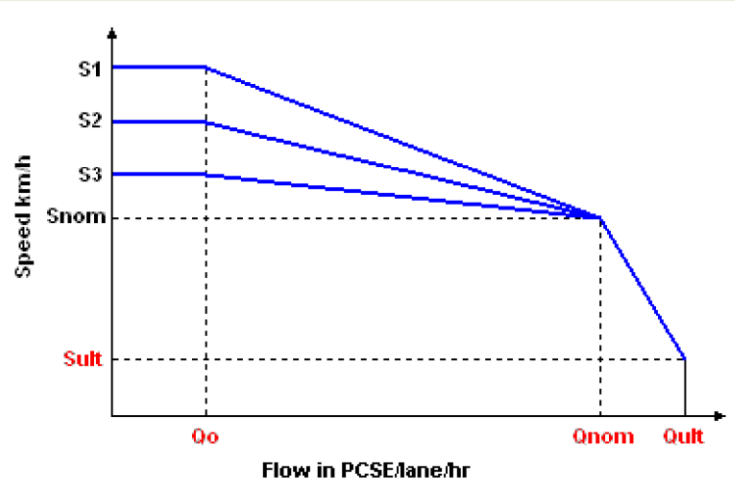


Figure II.1: HDM-4 Speed –Flow Model

2.3 HDM-4 CUSTOMIZATION

The configuration of HDM-4 under the Level 2 Calibration Study in 2014 involved additional customization of the HDM-4 workspace for Burkina Faso.

Lookup Tables

HDM-4 requires a considerable number of data items for each road section. To produce an HDM-4 compliant dataset, sensible default values were defined for these parameters. According to the Level 2 Calibration Study:

> "*The mechanism for the derivation of values for the missing data-items is the 'look-up table'. Essentially, the look-up table contains a list of 'representative sections' that encompasses the range of different road section types found on the Burkina Faso road network."*[45]

Customized HDM-4 Workspace

The HDM-4 workspace was set up containing all the configuration and calibration data determined in the Level 2 Calibration Study. The customized workspace is the responsibility of MOI DGNETC and it can be summarized as follows:

- Road network matrix for Burkina Faso for use in strategic level analysis
- Default work standards
- Vehicle fleet
- Climate zones
- Speed-flow types
- Traffic flow patterns
- Accident rates
- Road deterioration and works effects calibration factors
- Road user effects calibration factors
- Economic parameters
- Default inputs for asset valuation
- Traffic growth rates

III. VEHICLE FLEET CHARACTERISTICS AND UNIT COST CALIBRATION

As discussed in the introduction, the calibration of HDM-4 to local conditions aims to improve the accuracy of predicted road performance. Among the three levels of calibration, this report aims for level 1 calibration using existing resources and data. The following sections discuss in greater detail the level 1 calibration to be used for the evaluation in each topic area.

[45] HDM-4 Configuration and level 2 Calibration to Conditions in Burkina Faso, Final Report, IMES for GiZ & MCA, January 2014.

3.1 REPRESENTATIVE VEHICLES

The HDM-4 modeling of vehicle fleets uses representative vehicle classes reflecting the traffic composition being evaluated. Finalization of the vehicle classes/models should, where possible, await the initial traffic counts for the study to ensure maximum compatibility between components of the study and data inputs to HDM-4.

ECOWAS recommends the following vehicle classification of nine vehicle classes, which was adopted by the MOI for their program of regular traffic counts until 2012:

Class	Category
1	Car
2	Motorcycle
3	Minibus
4	Bus/Coach
5	Light Goods Vehicle
6	2-axle Medium Goods Vehicle
7	3-axle Heavy Goods Vehicle
8	Semi-Articulated Heavy Goods Vehicle
9	Articulated Heavy Goods Vehicle

Since 2012, however, MOI's traffic counting program has become less regular, with gaps in counting, including all of 2016, and delays in the analysis and processing. It is understood that administrative and financial issues are behind this decline in quality. The latest traffic countings also use a much more detailed classification of heavy goods vehicles (HGVS) than what is recommended by ECOWAS, based on axle and wheel configurations.

The initial field visits to each of the MCC-funded primary roads provided a general overview of the traffic using the roads. In general, four+ wheeled vehicles were less common with the considerable majority of traffic comprising two-wheelers. The team observed fewer conventional motorized vehicles but at least two additional types of non-motorized vehicles, the bicycle and animal cart.

This evaluation's data collection on road traffic will use a motorized vehicle classification broadly based upon the ECOWAS classification but including two non-motorized classes. The provisional HDM-4 vehicle classification for the evaluation is as follows:

Table 3.1 Vehicle Classes for HDM-4 Economic Evaluation

No.	Vehicle Class	Notes
1	Motorcycle	
2	Motor-tricycle*	
3	Car	
4	Minibus	4-wheels
5	Large Bus	6+wheels
6	Light Goods Vehicle	4-wheels
7	Medium Goods Vehicle	6-wheels
8	3-axle Heavy Goods Vehicle	Rigid
9	Articulated Heavy Goods Vehicle	Articulated 3+axle
10	Bicycle*	Nmt
11	Animal Cart*	Nmt

*Note: * indicates new vehicle classes added for the evaluation*
Source: The Evaluation Team

3.2 VEHICLE OPERATING COSTS

Based on the vehicle classification, the conventional practice is to then select an appropriate vehicle model for each vehicle class and collect VOC data for that particular model. Information on the selected model is collected from interviewing vehicle operators, traders, importers, garages, and workshops to build up a detailed picture of the VOC characteristics. Table 3.2 lists basic vehicle characteristics for each class as available and used for level 1 calibration and Table 3.3 summarizes the available vehicle operating cost inputs for HDM-4 in CFA. The information is taken from existing sources, cross-referenced where possible, with adjustments only to the 2016-17 price base using values from the IMF's World Economic Outlook Database of September 2016. Costs are economic costs and exclusive of taxes and subsidies.

Full details of the sources are given below. These are the best available sources at present, in line with the requirements of a level 1 calibration of HDM-4 which is defined as a desk-level study with no significant fresh data collection.

Table 3.2 VOC Sources

VOC Data	Source	Author	Date
VOC	HDM-4 workspaces	DGNETC	2014
VOC	HDM-4 Configuration and level 2 Calibration to Conditions in Burkina Faso, Final Report	IMES	January 2014
VOC	Road Project Economic Evaluation Consultancy, Draft Final Report	MCC consultant	June 2015
VOC	Pre-Investment Economic Evaluation using RED software	MCC consultant	2007
Price Changes	World Economic Outlook Database	IMF	September 2016
Exchange Rate	Currency Converter	www.oanda.com	December 2016

The Evaluation Team will conduct a thorough review and update the information in both Tables 3.2 and 3.3 using data from the traffic surveys (traffic counts and Origin-Destination surveys) and vehicle operating cost surveys. The monetary values for VOC will be carefully updated; the base data for Table 3.3 is at least three years old and the best practice is to conduct VOC surveys every two years. As noted above, the vehicle classification for the evaluation will additionally include motor tricycles and non-motorized classes. Most recent studies did not include non-motorized classes and many of the vehicle characteristics and costs do not apply to non-motorized classes.

Table III.3: Basic Characteristics of Motorized Vehicle Fleet

Vehicle Class	Motorcycle	Car	Minibus	Large Bus	LGV	MGV	HGV 3	Artic HGV
PCSE	0.5	1.0	1.2	1.5	1.0	1.4	1.6	1.8
Number of wheels	2	4	4	6	4	6	10	22
Number of axles	2	2	2	2	2	2	3	6
Tire type	Bias	Bias	Bias	Radial	Bias	Radial	Radial	Radial
Annual km	10,000	17,000	68,000	110,000	50,000	95,000	80,000	50,000
Working hours	400	410	1,140	1,300	875	1,267	1,200	923
Average life (years)	10	13	15	17	12	19	15	16
Private use (%)	25	71	-	-	-	-	-	-
Number of passengers	1	4	23	70	3	3	2	2
Work-related trips (%)	75	29	100	100	100	100	100	100
Equivalent Standard Axles (ESA)	0.0	0.01	0.03	0.6	0.01	3.38	5.52	9.29
Operating weight (t)	0.2	1.20	3.70	9.00	2.50	14.00	25.00	45.00

Primary Source: MOI DGNETC data updated by the Evaluation Team
** Note: In addition to motorized classes, two non-motorized classes – bicycles and animal carts - will be included for road traffic count for the evaluation.*

Table III.4: Vehicle Operating Costs (CFA) *[economic costs]*

Description	Motorcycle	Car	Minibus	Large Bus	LGV	MGV	HGV 3	Artic HGV
New vehicle price	320,000	6,500,000	13,500,000	75,100,000	16,250,000	15,700,000	25,500,000	62,600,000
Tire price	8,000	140,000	90,000	280,000	1,100,000	200,000	270,000	300,000
Fuel type	Petrol	Petrol	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Fuel price (/liter)	460	460	440	440	440	440	440	440
Lubricant price (/liter)	700	2,250	2,400	3,500	2,350	1,850	1,850	1,850
Maintenance cost (/hour)	600	1,000	1,500	1,000	1,500	1,900	1,900	1,900
Crew cost (/hour)	-	-	400	500	1,150	400	1,100	600
Tire retread cost (%)	15	15	15	25	30	30	30	35
Overheads	16,000	129,000	64,000	710,000	600,000	775,000	790,000	770,000
Rate of interest (%)	11	11	11	11	11	11	11	11

Primary Source: MOI DGNETC data updated by the Evaluation Team
** Note: In addition to motorized classes, two non-motorized classes – bicycles and animal carts - will be included for road traffic count for the evaluation.*

3.3 TRAVEL TIME

Passenger Travel Time

Savings in travel time is an important benefit from road rehabilitation. In line with the World Bank's recommendations[46], work and business time are valued at the full economic travel time rate under the assumption that an employee's value is equal to the wage rate plus any additional costs of employment. Non-work travel time are valued at a default value of 33% of the full rate.

Burkina Faso National Statistics is used to derive the economic value of travel time at the end of 2016. The gross average national wage is CFA 104,130 per month[47], equivalent to US$ 1.06 per hour. This figure is a national average covering urban and rural areas, the employed and self-employed. Additional cost of employment is estimated at 15% of national wage. Therefore, the total economic value of travel time is estimated at US$ 1.22 per hour (with non-work at US$ 0.40/hour).

Table 3.6 gives further details of the travel time calculations. The table shows the calculated values for three different time periods: 1) at the end of 2016, 2) 2014 when the MCC-funded primary road investments were completed, and 3) an average for the period of 2014-34 as the first 20 years of operation after road investment completion. This information is used to run the sensitivity modeling of travel time using the HDM-4 evaluation.

The projection of VoT costs over the project evaluation period has been carried out in line with expectations of growth in the national economy of Burkina Faso on the basis of country-specific forecasts from the IMF[48] over the short to medium term and broader international forecasts from the OECD[49] over the medium-long term.

There is currently insufficient available information to include non-motorized transport (nmt) in Table 3.6, previous studies having largely excluded them. Bicycles and animal carts will be modeled using HDM-4 on the basis of fresh survey data.

The values in Table 3.6 and the assumptions behind them will be reassessed during the early stages of data collection and updated with the latest data on the average national wage of Burkina Faso.

Full details of the sources are given below. These are the best available sources at present, in line with the requirements of a level 1 calibration of HDM-4 which is defined as a desk-level study with no significant fresh data collection.

Cargo Delay Cost

Cargo delay cost refers to the number of vehicle-hours spent in transit. Improved roads increase the travel distance of cargos within the same amount of time, thereby reducing the cargo delay cost. It is generally accepted that cargo time costs represent around 1.5 – 2.0 times the passenger working travel time cost. A conservative factor of 1.5, giving the latest 2016 value of US$ 1.83/hour, is used for level 1 HDM-4 calibration.

---

[46] Gwilliam, K M, The Value of Time in Economic Evaluation of Transport Projects, Infrastructure Note OT-5, World Bank, Washington DC, USA. 1997. [Available online at http://www.worldbank.org/transport/publicat/td-ot5.htm].
[47] "Cost of Living in Burkina+Faso". Prices in Burkina+Faso. Numbeo, Dec. 2016. Web. 01 May 2017.
[48] "World Economic Outlook Database." International Monetary Fund. IMF, Oct. 2016. Web. 01 May 2017.
[49] "Looking to 2060: Long-term global growth prospects", OECD, November 2012.

Table 3.5 Travel Time Sources

Travel Time Data	Source	Author	Date
Work/non-work split	World Bank, Infrastructure Note No. OT-5	World Bank (Gwilliam K. M.)	1997
Gross average national wage	Prices in Burkina Faso	www.numbeo.com	2016
Growth in national economy	World Economic Outlook Database	IMF	October 2016
Growth in international economy	Looking to 2060: Long-term global growth prospects	OECD	November 2012
Exchange Rate	Currency Converter	www.oanda.com	December 2016

Table 3.6: Burkina Faso - Valuation of Travel Time

		US$ / Year 2016	US$ / month - 2016	US$ / hour - 2016
Hours worked per month	160			
Average Wage (end 2016)		2,031	169	1.06
Average Wage + 15% social charges etc. (end 2016)		2,336	195	1.22

Work and Non-Work Time Values

	US$ / hour		
	Work Travel	Non-work travel	
Motorcyclists, car drivers and all passengers in 2016	1.22	0.40	
Motorcycylists, car drivers and all passengers 2014-2034	1.90	0.63	*(Evaluation period, 2014-34)*
Motorcyclists, car drivers and passengers in 2014	1.19	0.39	*(Project opening year)*

Trip Purpose by Vehicle Type

Vehicle category	Work (%)	Non-work (%)
Motorcyclists	75	25
Car drivers and passengers	30	70
Minibus passengers	50	50
Pickup passengers (LGV)	50	50
Bus passengers	50	50
MGV/HGV passengers	90	10

Trip Purpose Adjusted Time Values (2014-34)

Vehicle category	Work ($ / hour)	Non-work ($ / hour)	Weighted average ($ / passenger hour)	Weighted average ($ / vehicle hour)	Proportion (Project Roads)	$ cents/veh min
Motorcyclists	1.90	0.63	1.58	1.58	0.885	2.63
Car drivers and passengers	1.90	0.63	1.01	4.03	0.060	6.71
Minibus passengers	1.90	0.63	1.26	27.73	0.008	46.22
Pickup passengers	1.90	0.63	1.26	2.52	0.006	4.20
Bus Passengers	1.90	0.63	1.26	86.98	0.010	144.97
MGV/HGV passengers	1.90	0.63	1.77	3.54	0.031	5.90

Trip Purpose Adjusted Time Values (2014)

Vehicle category	Work ($ / hour)	Non-work ($ / hour)	Weighted average ($ / passenger hour)	Weighted average ($ / vehicle hour)	Proportion (Project Roads)	$ cents/veh min
Motorcyclists	1.19	0.39	0.99	0.99	0.885	1.65
Car drivers and paasengers	1.19	0.39	0.63	2.52	0.060	4.20
Minibus passengers	1.19	0.39	0.79	17.36	0.008	28.93
Pickup passengers	1.19	0.39	0.79	1.58	0.006	2.63
Bus Passengers	1.19	0.39	0.79	54.43	0.010	90.72
MGV/HGV passengers	1.19	0.39	1.11	2.21	0.031	3.69
	Light vehicles					2.04
	Heavy vehicles					24.92

Average Vehicle Occupancy

Vehicle type	Average No. of Passengers
Motorcyclists	1.0
Passenger cars	4.0
Minibuses	22.0
Pickups & LGVs	2.0
Buses	69.0
MGVs 2-axle	2.0
HGVs 3-axle	1.0
HGVs >3-axle	1.0

Note: Exchange rate used: $1 = CFA615.11 (Dec 2016) (www.oanda.com)

IV. ROAD NETWORK CHARACTERISTICS CALIBRATION

4.1 ROAD SECTIONS AND INVENTORY

HDM-4 bases its modeling on road sections of homogeneous traffic. These sections can be subdivided based on significant variations in highway engineering characteristics, notably road inventory or road surface condition.

The functional classification for the road network in Burkina Faso includes the following categories:

- Routes Nationales, referred to as “RN”
- Routes Régionales, referred to as “RR”
- Routes Départementales, referred to as “RD”

The HDM-4 modeling for the Burkina Faso Roads Project covers three primary road sections in western Burkina Faso:

- RN14: Dedougou – Nouna – Mali border (145 km)
- RR21: Banfora – Sindou (50 km)
- RN13/RN21: Sabou – Koudougou – Didyr (76 km)

The HDM-4 workspace held by DGNETC of MOI breaks down the three MCC-funded primary roads into sub-sections shown in Table 4.1 below.

Table 4.1: MCC-funded Primary Road Sections

Road no./ Section no.	From	To	km
RN14-13	Dedougou	Koudougou mossi	11.7
RN14-14	Koudougou mossi	Kolonkoura	38.0
RN14-15	Kolonkoura	Nouna	5.4
RN14-16	Nouna	Soin	6.7
RN14-17	Soin	Konakoira	17.4
RN14-18	Konakoira	Bomborokui	13.4
RN14-19	Bomborokui	Djibasso	25.8
RN14-20	Djibasso	Mali border	21.4
RR21-1	Banfora	Wolonkoto	25.0
RR21-2	Wolonkoto	Douna	15.2
RR22-2	Douna	Sindou	8.6
RN13-7	Koudougou	Sourgou	16.9
RN13-8	Sougou	Sabou	10.3
RN21-1	Koudougou	Reo	12.2
RN21-2	Reo	Didyr	37.6

Source: MOI DGNETC
Note: Section reference numbers are from the MOI HDM-4 workspace

Table 4.2 below summarizes the road inventory data of MCC-funded primary roads from the MOI workspace.

Table 4.2: Road Inventory of MCC-funded Primary Roads

Section No.	Length	Width	Rise and fall	Horizontal curvature	Altitude	Surface Type	
	km	m	m/km	deg/km	m	Old	New
RN14-13	11.707	9.0	3.0	50	350	Gravel	DBST
RN14-14	37.979	9.0	3.0	50	350	Gravel	DBST
RN14-15	5.386	9.0	3.0	50	350	Gravel	DBST
RN14-16	6.720	9.0	3.0	50	350	Gravel	DBST
RN14-17	17.405	9.0	3.0	50	350	Gravel	DBST
RN14-18	13.363	9.0	3.0	50	350	Gravel	DBST
RN14-19	25.825	9.0	3.0	50	350	Gravel	DBST
RN14-20	21.419	9.0	3.0	50	350	Gravel	DBST
RR21-1	25.031	6.0	3.0	50	350	Gravel	DBST
RR21-2	15.162	6.0	3.0	50	350	Gravel	DBST
RR22-2	8.559	6.0	3.0	50	350	Gravel	DBST
RN13-7	16.929	7.0	3.0	50	350	Gravel	DBST
RN13-8	10.263	7.0	3.0	50	350	Gravel	DBST
RN21-1	12.184	7.0	3.0	50	350	Gravel	DBST
RN21-2	37.617	7.0	3.0	50	350	Gravel	DBST

Source: MOI DGNETC/HDM-4/MCC
Note: DBST = Double Bituminous Surface Treatment
** Speed limits for RN14 are 100 kph and, for RN21 and RR21, 80 kph.*

4.2 SEROAD CONDITIONS

HDM-4 uses road roughness, measured in International Roughness Index (IRI) (m/km) as its primary index of road surface condition. Roughness for each of the study road sections before and after investment are summarized in Table 4.3 below.

Table 4.3: Road Roughness by Road Section

Section No.	Roughness IRI (m/km)	
	Before Investment	After Investment
RN14-13	14.0	3.5
RN14-14	14.0	3.5
RN14-15	14.0	3.5
RN14-16	14.0	3.5
RN14-17	14.0	3.5
RN14-18	14.0	3.5
RN14-19	22.0	3.5
RN14-20	22.0	3.5
RR21-1	14.0	3.5
RR21-2	14.0	3.5
RR22-2	14.0	3.5
RN13-7	14.0	3.5
RN13-8	14.0	3.5
RN21-1	12.0	3.5
RN21-2	14.0	3.5

Source: MCC

MCC-funded primary roads were gravel roads before upgrading and the HDM-4 does not require other measures of surface distress for gravel roads. The Level 2 Calibration Study classified these road sections, prior to investment, as either fair (10-15 IRI) or poor (>15) unpaved road surfaces.

V. TRAFFIC CHARACTERISTICS CALIBRATION

5.1 TRAFFIC CHARACTERISTICS

Traffic is a critical input to the HDM-4 modeling. Traffic data is calculated as classified Annual Average Daily Traffic (AADT) for a specified year (prior to intervention in the case of an investment project) for each road section.

Existing, or pre-investment, traffic data was obtained from traffic counts conducted by the Regional Directorates (RDs) on behalf of the MOI. These consisted of 7-day counts taken before and after the rainy season which formed the basis of estimates of AADT for each road section.

The traffic data available for the level 1 calibration does not include all of the vehicle classes that the Evaluation Team intends to include for the evaluation (see Chapter 3.1 for more detail). The available data excludes two and three wheelers and non-motorized classes. These vehicle classes are highly significant due to their high traffic on MCC-funded primary roads but conventionally AADT is defined as four+ wheeled motorized classes.

During data collection, the Evaluation Team will confirm the monthly and seasonal variation factors needed to reliably convert Average Daily Traffic (ADT) from traffic counts to AADT.

Table 5.1 below presents classified 2011 AADT estimates for the MCC-funded primary road sections.

Table 5.1 Traffic (AADT) by Project Primary Road Section

Section No.	Annual Average Number of Vehicles per Vehicle Class							
	Car	Minibus	Large Bus	LGV	MGV	HGV 3	Artic HGV	Total AADT estimate
RN14-13	57	13	6	9	26	6	2	**119**
RN14-14	41	12	5	5	13	4	1	**81**
RN14-15	41	12	5	5	13	4	1	**81**
RN14-16	23	4	1	3	16	9	0	**56**
RN14-17	15	4	1	1	11	6	0	**38**
RN14-18	15	4	1	1	11	6	0	**38**
RN14-19	11	3	1	1	8	5	0	**29**
RN14-20	5	3	2	1	2	1	1	**15**
RR21-1	48	18	1	14	16	2	1	**100**
RR21-2	48	18	1	14	16	2	1	**100**
RR22-2	50	13	0	6	7	1	1	**78**
RN13-7	57	17	4	16	20	12	8	**134**
RN13-8	57	17	4	16	20	12	8	**134**
RN21-1	172	36	13	32	35	9	4	**301**
RN21-2	80	38	9	23	23	5	3	**181**

Source: MOI DGNETC
Note 1: 2011 AADT estimates
Note 2: Sections and their reference numbers are from the MoI HDM-4 workspace

5.2 TRAFFIC GROWTH

Normal Traffic Growth

Traffic growth is driven by economic development and reflects the increasing prosperity of society and the attendant increases in vehicle ownership and vehicle usage.

The strong relationship between economic growth and traffic growth is clear in the developing stage of an economy. Cars and other passenger vehicle traffic generally grow slightly faster than the GDP while goods vehicle traffic, closely linked with the economy, increase more closely in line with the GDP growth.

For traffic growth forecasts until 2021, the IMF's national economic forecasts for Burkina Faso[50] are used as a starting point of developing central growth scenario of the national economy. For the remainder of the evaluation period (2022-2034), the model uses a longer term economic forecast on the prospective development of non-OECD countries (conducted by OECD)[51].

[50] "World Economic Outlook Database." International Monetary Fund. IMF, Oct. 2016. Web. 01 May 2017.
[51] "Looking to 2060: Long-term global growth prospects", OECD, November 2012.

A comparison of the observed traffic growth on national roads with the actual national economic growth in Burkina Faso indicates that elasticity values of 1.13 for passenger traffic and 1.03 for goods vehicles are appropriate in the short term, to 2020. Thereafter, 1.05 and 1.00 respectively are proposed for passenger and goods vehicles.

The annual growth rates are summarized in Table 5.2. Low growth scenario takes 80%, and high growth scenario 120%, of central growth scenario (100%). Low and high growth scenarios can be included in HDM-4's sensitivity analysis.

Table 5.2 Normal Traffic Growth Rates

Years	Passenger Vehicles			Goods Vehicles		
	Low (80%)	Central (100%)	High (120%)	Low (80%)	Central (100%)	High (120%)
2011-2013	-	7.3	-	-	6.7	-
2014-2020	4.7	5.9	7.1	4.3	5.4	6.5
2021-2025	4.2	5.2	6.3	4.0	5.0	6.0
2026-2030	3.4	4.2	5.1	3.2	4.0	4.8
2031-2034	2.9	3.7	4.4	2.8	3.5	4.2

Source: IMF, World Economic Outlook Database October 2016

Generated Traffic Growth

The RED economic assessment of the MCC-funded primary roads carried out for MCC applied a price elasticity of demand of 0.9 for traffic demand in relation to the cost of transport. In other words, for every one unit reduction in transport cost, there will be a 0.9 increase in transport demand. This relationship provides a conservative and credible starting point for the HDM-4 modeling which will include with and without generated traffic as one of its sensitivity tests.

Table 5.3 Traffic Data Sources

Traffic Data	Source	Author	Date
Road sub-sections	HDM-4 workspaces	DGNETC	2014
Road Inventory	HDM-4 workspaces	DGNETC	2014
International Roughness Index	MCC RED Economic Analysis	MCC Consultant	2011
Traffic counts	Traffic count database	DGNETC	2011
Normal traffic growth rate	World Economic Outlook Database	IMF	to 2014
Normal traffic growth rate	Looking to 2060: Long-term global growth prospects	OECD	November 2012

VI. CLIMATE ZONES CALIBRATION

In HDM-4, the climate is classified using temperature and moisture classifications. The definition of climate zones used to calibrate HDM-4 to Burkina Faso in the Level 2 Calibration Study remains appropriate for use in the current evaluation.

Most of Burkina Faso's land falls within the semi-arid climate classification with temperature ranging between 18C and 40C. Delineation of the country into climate zones was, therefore, largely influenced by variation in annual rainfall. The following three climate zones were proposed in the Level 2 Calibration Study (illustrated in Figure 6.1):

- Sahelian Zone: annual rainfall lower than 600 mm (pink on Figure 6.1)
- Sudano-Sahelian Zone: annual rainfall between 600 and 900 mm (light blue on Figure 6.1)
- Sudanese Zone: annual rainfall between 900 and 1200 mm (darker blue on Figure 6.1)

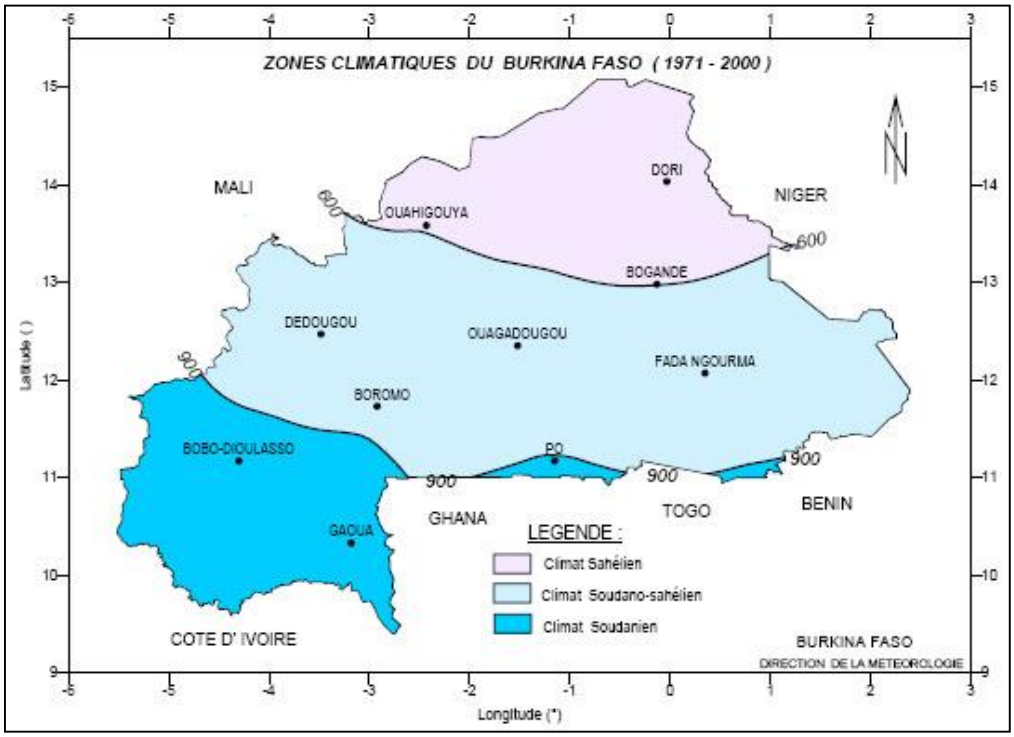


Figure 6.VI.1: Burkina Faso Climatic Zones[52]

Climate data from the Burkina Faso Meteorological Department was used to define the parameters required for input into HDM-4. These parameters are provided below in Table 6.1.

Two MCC-funded primary roads (Dedougou – Nouna- Mali, Sabou – Koudougou – Didyr) lie within the Sudano-Sahelian climatic zone and the Banfora – Sindou primary road section lies within the Sudanese zone.

[52] Meteorological Department of Burkina Faso/IMES for GiZ/MCA

Table 6.1: Climate Zone Parameters

Name	Description	Moisture Classification	Temperature Classification	Number of Days when Temperature Exceeds 32ºC	Average Temperature Range (ºC)	Freeze Index	Moisture Index	Mean Monthly Precipitation (mm)	Mean Temperature (C)	Duration of Dry Season (months)	Percentage of Driving on Snow Covered Roads	Percentage of Driving Done on Water Covered Roads
Zone 1 (Sahelian zone)	Annual average rainfall lower than 600mm	Semi-arid	Tropical	241	13	0	-40	40	29	8	0	5
Zone 2 (Sudano - Sahelian zone)	Annual average rainfall between 600 and 900 mm	Semi-arid	Tropical	209	13.3	0	-30	66	28.3	7	0	10
Zone 3 (Sudanese zone)	Annual average rainfall between 900 and 1200 mm	Sub-humid	Tropical	158	9	0	0	91	27	7	0	15

Source: Meteorological Department of Burkina Faso/IMES for GiZ/MCA

VII. ROAD WORKS COSTS AND ALTERNATIVE FUTURE STRATEGIES

Alternative Future Strategies

HDM-4 compares a "without-project" situation with one or more "with-project" situations. This enables the net economic impact of the proposed scheme(s) to be estimated. The without-project situation should represent a realistic treatment of the road in the absence of project approval.

The economic modeling consists of a minimum of two scenarios:

- Do-Minimum (without-project)
- Do-Something (with project)

The Do-Minimum scenario consists of regular grading and re-gravelling of the project roads in line with established best practice in Burkina Faso. The Do-Something scenario refers to the MCC road investment.

Unit Costs of Road Investment

Unit cost rates for road works under the Do-Something scenario were costed on a section-specific basis. Table 7.1 below details the per kilometer capital costs for each section of the Project Primary Roads.

Table 7.1: Capital Costs of Rehabilitation Projects

Section No.	Capital Costs (m CFA/km)
RN14-13	194.191
RN14-14	194.191
RN14-15	194.191
RN14-16	194.191
RN14-17	194.191
RN14-18	194.191
RN14-19	194.191
RN14-20	194.191
RR21-1	186.842
RR21-2	186.842
RR22-2	186.842
RN13-7	153.290
RN13-8	153.290
RN21-1	184.104
RN21-2	156.488

Source: MCC Economic Evaluation using RED software, 2007

Details of Road Investment Project

The HDM-4 engineering input for the MCC-funded primary roads are summarized below:

- Road width: 7.0m
- Shoulder width: 1.5m
- Surface type: Double Bituminous Surface Treatment (DBST)
- Base type: Granular
- Surface thickness: 25 mm
- Structural number:
    - Dedougou – Nouna: 3.98
    - Nouna – Djibasso: 4.45
    - Djibasso – Mali border: 4.39
    - Banfora – Sindou: 3.98
    - Sabou – Koudougou: 4.20
    - Koudougou – Didyr: 4.76
- Rise and fall: 3m/km
- Average horizontal curvature: 50 deg/km

Sources: MCC/Road Project Economic Evaluation Consultancy, Draft Final Report, June 2015

VIII. PROJECT ECONOMIC EVALUATION PARAMETERS

Discount Rate

A discount rate of 10% is proposed for this project based on the latest calculation of the MCC hurdle rate.

Evaluation Period

The evaluation period will commence with project opening year, in each case 2014. Final evaluation year would then be 2034, to cover 20 complete years of operation following the MCC investment. The evaluation will use constant prices, as is common practice in HDM-4 evaluations, to a 2014 base.

Accident Costs

Accident costs and benefits cannot be included in the economic evaluation because of difficulties to date in obtaining reliable accident rates for the MCC-funded primary roads. In addition, the net effect on road safety, accident rates and costs of the primary roads may be ambiguous without being supported by a major program of road safety education and enforcement.